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# Hazardous Waste TSDF: Technical Guidance Document for RCRA Air Emission Standards for Process Vents and Equipment Leaks

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# Hazardous Waste TSDF - Technical Guidance Document for RCRA Air Emission Standards for Process Vents and Equipment Leaks

RCRA

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# Hazardous Waste TSDF - Technical Guidance Document for RCRA Air Emission Standards for Process Vents and Equipment Leaks

Emission Standards Division

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

July 1990

## Guideline Series

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# 1.0 INTRODUCTION

## 1.1 PURPOSE

This document is designed to provide technical guidance for Resource Conservation and Recovery Act (RCRA) permit writers and reviewers to implement the process vent and equipment leak organic air emission standards for hazardous waste treatment, storage, and disposal facilities (TSDF). This guidance document provides information needed to assess the applicability of the air standards for process vents and equipment leaks to TSDF emission sources and the conformance of emission controls to standard requirements. The document can also be used as a reference to train RCRA permit writers, reviewers, and applicants (hazardous waste TSDF owners and operators). It also identifies additional training materials and existing EPA courses relevant to the standards.

These standards (promulgated 55 FR 25454, June 21, 1990; see Appendix A) have been developed under Section 3004(n) of the Hazardous and Solid Waste Amendments (HSWA) to the RCRA of 1976. The process vent and equipment leak standards appear in the Code of Federal Regulations, Parts 264 and 265, Subparts AA and BB, respectively. The equipment leak provisions incorporate requirements that have been promulgated under the Clean Air Act (CAA) for equipment in benzene and vinyl chloride service and for equipment in the synthetic organic chemical manufacturing industry (SOCMI).

Both Parts 264 and 265, Subpart AA standards for process vents and Subpart BB standards for equipment leaks, are considered by EPA to be "self-implementing"; i.e., the standards can be satisfied without the need for detailed explanation or negotiation between the facility owner/operator and EPA. This is achieved by including specific criteria for facility owners/operators that can be used to identify waste management units that are subject to the regulations and by clearly specifying the emission control and administrative requirements of the rules. To demonstrate compliance, facilities must document their emission estimates and control device efficiencies with design/engineering analyses based on criteria contained in the rules (e.g., either engineering calculations or source tests can be used to document compliance with the process vent emission limit) and must maintain these and monitoring, leak detection, and repair records in their operating record.

This and other EPA guidance documents do not supersede the regulations promulgated under RCRA and published in the Code of Federal Regulations. Instead, they provide guidance, interpretations, suggestions, and references to additional information.

## 1.2 FUTURE REGULATORY ACTIONS

The development of TSDF air standards is being performed in phases. In Phase I, EPA promulgated standards (55 FR 25454, June 21, 1990) to control organic air emissions from process vents and equipment leaks at hazardous waste TSDF. The regulations developed in Phase II would supplement those standards by establishing air standards for additional waste management operations at hazardous waste TSDF. These waste management operations include surface impoundments, storage and treatment tanks (including vents on closed, vented tanks), containers, and miscellaneous units.

The regulations promulgated in the first two phases control emissions of organics as a class rather than controlling emissions of individual waste constituents. If necessary, additional guidance/regulations to further reduce emissions and risk, after implementing the first two phases, will be developed in Phase III of the TSDF regulatory approach.

## 1.3 DOCUMENT OUTLINE

The organization of this document is shown in Table 1-1.

TABLE 1-1. GUIDANCE DOCUMENT ORGANIZATION

| Chapter/Appendix | | Description |
|---|---|---|
| Chapter 1.0: | Introduction | Discussed in this chapter are the purposes and organization of this document. |
| Chapter 2.0: | Summary of the Regulation | The air emission standards for process vents and equipment leaks are briefly summarized in this chapter. |
| Chapter 3.0: | Affected Sources | This chapter contains discussions on the applicability of the standards and provides examples that can be used to determine applicability. |
| Chapter 4.0: | Equipment Leaks | Discussed in this chapter are the types of equipment subject to the standards, estimates of uncontrolled fugitive emissions from equipment, equipment leak control requirements, and repair methods. |
| Chapter 5.0: | Process Vents | The processes affected by the standards are briefly described along with methods for estimating process vent emissions, and vent emission control options. |
| Chapter 6.0: | Testing and Evaluation | Discussed here are the sampling and analytical procedures that will be used to determine applicability criteria and monitoring. |
| Chapter 7.0: | Inspection, Monitoring Recordkeeping, and Reporting | This chapter reviews the inspection, monitoring, recordkeeping, and reporting requirements of the rules. |
| Chapter 8.0: | Implementation and Compliance | This chapter contains discussions on implementation, compliance, and enforcement of the standards in relation to the RCRA permitting process. |
| Chapter 9.0: | Training | This chapter provides guidance regarding available material that could be used in training and information on existing EPA courses. |
| A: | Federal Register Notice | |
| B: | How to Pack a Pump | |
| C: | Condenser Design | |
| D: | Calculations for Condensers on a Thin-Film Evaporator (Distillation) Unit | |
| E: | The Effect of Concentration on Condenser Efficiency and Emissions | |
| F: | Design Checklists | |
| G: | Carbon Canister Monitoring Frequency | |

## 2.0 SUMMARY OF THE REGULATION

The standards (promulgated 55 FR 25454, June 21, 1990) limit emissions of organics from certain process vents and equipment leaks at new and existing hazardous waste TSDF requiring a RCRA permit under RCRA Subtitle C (i.e., TSDF that need authorization to operate under RCRA Section 3005[e]). This applicability includes all hazardous waste management units that are subject to the permitting requirements of Part 270 and hazardous waste recycling units that are located on hazardous waste management facilities otherwise subject to the permitting requirements of Part 270.

### 2.1 PROCESS VENTS (SUBPART AA)

The standards are applicable to vents on affected hazardous waste management units that manage hazardous waste with an annual average total organics concentration of 10 parts per million by weight (ppmw) or greater and specifically include: (1) process vents on distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping operations and vents on condensers serving these operations, and (2) process vents on tanks (e.g., distillate receivers, bottoms receivers, surge control tanks, separator tanks, and hot wells) associated with distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping processes if emissions from these process operations are vented through the tanks.

To comply with the process vent standards, the facility owner/operator is required to identify all process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, and stripping processes that are handling or processing hazardous wastes that manage wastes exceeding the applicability criterion of 10 ppmw total organics (i.e., vents affected by the process vent standard). Up-to-date information and data used to determine whether or not a hazardous waste management unit and its associated process vent(s) are subject to the Subpart AA standards must be maintained in the facility operating record (Sections 264.1035(e) and 265.0135(e)). For example, documentation of a waste analysis showing that the waste managed in a distillation unit is less than the 10-ppmw applicability criterion must be kept in the facility operating record.

The owner/operator must then determine emission rates (through engineering calculations or direct source tests) for each vent and for the entire facility from all affected vents. Total facility process vent emission rates must then be compared to the short- and long-term process vent emission rate limit (1.4 kg/h or 2.8 Mg/yr [3 lb/h or 3.1 short tons/yr]) to determine if additional emission controls are required. Facilities with organic emissions from affected vents that never exceed the emission rate limit are not required to install controls or monitor process vent emissions under this rule. If the process vent emission rate limit is exceeded, the owner/ operator must install additional controls or change waste management process operations to reduce total facility process vent emissions to below the cutoff or install additional controls to reduce total facility process vent organic emissions from all affected vents by 95 weight percent; if enclosed combustion devices are used, the owner/operator has the option of reducing the organic concentration of each affected vent stream to a total organic compound concentration of no more than 20 parts per million by volume (ppmv), expressed as the sum of the actual compounds on a dry basis corrected to 3 percent oxygen. The standards for process vents do not require the use of any specific equipment or add-on control devices. Condensers, carbon adsorbers, incinerators, boilers, process heaters, and flares are applicable and demonstrated emission control devices for the regulated processes, although the choice of control is not limited to these.

Regardless of the technology selected by the facility, estimates of process vent emissions and emission reductions achieved by add-on control devices must be thoroughly documented, including certification of 95 percent reduction capability for control equipment. This information and documentation must be kept on record and must be included in the facility's Part B application. The implementation schedule, also required as Part B information, establishes dates for installation of the required emission controls for each particular facility.

The standards for process vents contain requirements that specific control device operating parameters be monitored continuously (Sections 264.1034 and 265.1034) and the monitoring information be recorded in the facility operating record to ensure that the devices perform according to their design and are properly operated and maintained. Operating parameters are specified for condensers, carbon adsorbers, flares, incinerators, and other enclosed combustion devices. While minimum operating conditions are identified for organic vapor destruction devices (e.g., incinerators and flares) to ensure 95 percent destruction, values or ranges of values for recovery device (i.e., condensers and carbon adsorbers) operating parameters cannot be specified on an industry-wide basis. A recovery device must be designed for a particular application and monitored to ensure that it is being operated within design specifications. (Note: This is an important point for permit writers/reviewers to keep in mind when evaluating control device efficiencies.) Proper design shall be determined through and documented by engineering calculations, vendor certification, and/or emission testing, although the use of emission testing to determine compliance with efficiency requirements is expected to occur only rarely. For facilities with final RCRA permits, periods when monitoring data indicate that control device operating parameters exceed established tolerances for design specifications for more than 24 hours must be reported on a semiannual basis. The records and reports must include dates, duration, cause, and corrective measures taken. (Note: Air standards also have been promulgated for the control of air emissions from permitted hazardous waste incinerators (40 CFR 264, Subpart O). These standards require that incinerators burning hazardous waste be operated to achieve a destruction and removal efficiency (DRE) of at least 99.99 percent for those primary organic hazardous constituents listed in the facility permit. However, the process vent stream (i.e., gases and vapors) from a hazardous waste management unit would not be classified as a hazardous waste. Noncontainerized gases emitted from hazardous wastes are not themselves hazardous wastes because the RCRA statute implicitly excludes them. Therefore, combustion of process vent streams in an incinerator is not subject to the 99.99 DRE requirement.)

## 2.2 EQUIPMENT LEAKS (SUBPART BB)

The equipment leak standards apply to emissions from valves, pumps, compressors, pressure relief devices, sampling connection systems, and open-ended valves or lines. Under the final standards, controls for these sources are required at TSDF where the equipment contains or comes in contact with hazardous waste streams with 10 percent or greater total organics content (by weight). The owner/operator of a facility may choose any of the applicable test methods identified in the Subpart BB rules for determining the organic content of wastes managed at the facility.

To comply with the equipment leak standards, the facility owner/operator must identify all affected equipment (i.e., pumps, valves, compressors, etc., that contain or contact hazardous waste streams with organic concentrations that will ever equal or exceed 10 percent by weight); establish which affected equipment are in heavy-liquid service; and determine which valves are unsafe or difficult to monitor. By the effective date of this regulation (promulgation plus 6 months), the facility owner/operator must conduct the initial monthly monitoring survey of pumps and valves in light-liquid service. (Note: A vapor pressure cutoff specified in Section 260.10 defines equipment in light-liquid service.) A number of portable volatile organic detection devices are capable of detecting equipment leaks. Any analyzer can be used, provided it meets the specifications and performance criteria set forth in EPA Reference Method 21 (contained in Appendix A of 40 CFR Part 60).

Affected compressors must be equipped with a dual mechanical seal system that includes a barrier fluid system or must be designated as having "no detectable emissions." Sampling connections must be equipped with a closed-purge system. Open-ended valves or lines must be equipped with a cap, blind flange, plug, or a second valve. Pressure relief devices must be operated with "no detectable emissions." These types of equipment and available controls are discussed in Chapter 4.0.

## 2.3 MONITORING, RECORDKEEPING, AND REPORTING

Under the RCRA general inspection requirements, Sections 264.15 and 265.15, the owner/operator of a facility is required to inspect his facility for malfunctions, deterioration, operator errors, and discharges that could result in hazardous waste release or threat to human health. The owner/

operator is responsible for developing and following an inspection schedule and for maintaining a copy of the schedule at the facility. Monitoring, recordkeeping, and reporting are also required by the process vent and equipment leak provisions. Each TSDF owner/operator subject to the provisions of Parts 264 and 265, Subparts AA and BB, must comply with the monitoring and testing requirements of Sections 264.1034, 265.1034, 264.1063, and 265.1063. Additional information on monitoring and inspection requirements are contained in Section 7.1 of this document.

All TSDF owners/operators subject to the provisions of Subparts AA and/or BB must comply with the recordkeeping requirements of Sections 264.1035, 264.1064, 265.1035, or 265.1034. An owner/operator of more than one facility subject to these requirements may comply with the recordkeeping requirements for these hazardous waste management units with one recordkeeping system if the system identifies each record by each hazardous waste management unit.

In Chapter 7.0 of this document, Sections 7.2 and 7.3 outline the general RCRA recordkeeping requirements and the specific recordkeeping and reporting requirements of the process vent and equipment leak air emission standards. Table 7-1 summarizes the recordkeeping and reporting requirements of the process vent and equipment leak air emission standards.

The standards for process vents and equipment leaks for RCRA-permitted facilities subject to the provisions of Part 264, Subparts AA and BB, require that control device exceedances (i.e., occasions when monitoring indicates control device operating parameters are outside or exceed tolerances on design specifications) not corrected within 24 hours be reported to the Regional Administrator on a semiannual basis. (See Section 7.2.2 for a discussion of control device exceedances.) The reports must include the dates, duration, cause, and corrective measures taken. For equipment leaks, a report is required if a leak is not repaired within the designated time period. If a facility does not have any exceedances during the reporting period, no report is required. There are no reporting requirements for interim-status facilities subject to these air standards.

# 3.0 AFFECTED SOURCES

## 3.1 APPLICABILITY OF THE PROCESS VENT AND EQUIPMENT LEAK STANDARDS

The Subpart AA and BB standards do not expand the RCRA-permitted community for the purposes of air emissions control. As promulgated, the standards control organic emissions as a class from process vents and equipment leaks at hazardous waste TSDF that are subject to permitting requirements under RCRA Section 3005 and are applicable only to specific hazardous waste management units. The rules apply to hazardous waste management units that are subject to the permitting requirements of Part 270 and to hazardous waste recycling units that are located at facilities otherwise subject to the permitting requirements of Part 270. Exempt units other than recycling units (e.g., 90-day accumulation tanks and wastewater treatment units as specified in Section 270.1(c)(2)) are not subject to the rules even when they are part of a permitted facility.

Subparts AA and BB apply to owners or operators of facilities that recycle hazardous wastes only if they are subject to the requirements of Parts 264 or 265 due to other hazardous waste activities at the facility (Section 261.6[d]). Although recycling units such as batch distillation processes are exempt from permit requirements under RCRA, if a facility is subject to RCRA permit requirements independent of Subparts AA and BB (e.g., because of hazardous waste storage tanks on-site), then all the process vents and equipment at the facility are subject to the requirements of these standards, provided the process vents and equipment meet the other applicability criteria.

The Subpart AA regulations apply specifically to process vents associated with hazardous waste distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping operations that manage hazardous waste with 10 ppmw or greater total organics concentration on a time-weighted, annual average basis. The concentration of organics in the vent is not a consideration in determining applicability. The final rules for process vents require that the owner or operator subject to the provisions of Subpart AA comply with one of the following: (a) reduce total organic emissions from all affected vents at the facility to below 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 ton/yr), or (b) install control devices that reduce total organic emissions from all affected vents at the facility by 95 weight percent or, for enclosed combustion devices, to a total organic compound concentration of 20 ppmv or less (expressed as the sum of actual compounds, on a dry basis corrected to 3 percent oxygen). The Subpart BB equipment leak standards apply to equipment that contains or contacts hazardous waste with organic concentrations at least 10 percent by weight (Sections 264.1050[b] and 265.1050[b]).

If the owner or operator of a TSDF with sources potentially affected by the requirements of Part 264, Subparts AA or BB, has received a permit under Section 3005 of RCRA prior to the effective date (Sections 264.1030[c] and 264.1050[c], respectively), then the standards are not applicable until the permit is reissued under Section 124.15 or reviewed under Section 270.50. Permits issued after the effective date will incorporate the requirements of these regulations. If the owner or operator of an interim-status facility with sources potentially subject to the requirements of Part 265, Subparts AA and BB, has submitted a Part B application under Section 3005 of RCRA, the requirements of Subparts AA and BB will still apply. In these cases, permit applicants will be required to revise their Part B permit application and incorporate the requirements of these standards.

## 3.2 RELATIONSHIP OF RCRA EXEMPTIONS TO FINAL STANDARDS

The types of facilities or units that are listed below are exempt from the process vent and equipment leak air emission standards. Explanation of each of the exemptions is provided in the following paragraphs.

1. Units such as product (not hazardous waste) distillation columns generating organic hazardous waste still bottoms are not subject to the standards while the wastes are in the product distillation column unit.
2. Totally enclosed treatment facilities.
3. Elementary neutralization and wastewater treatment tanks as defined by 40 CFR 260.10.

4. Generators that accumulate hazardous waste in tanks and containers for 90 days or less. (Note: The EPA intends to modify this exemption at a later date.)

5. Closed-loop recycling (reclamation) units.

6. Units exempted under the domestic sewage exclusion (i.e., publicly owned treatment works [POTW] receiving hazardous wastes).

7. Units managing Subtitle D wastes.

### 3.2.1 Production Units

Under 40 CFR 261.4(c), hazardous wastes that are generated in process-related equipment such as product or raw material storage tanks or pipelines are exempt from RCRA regulation. This exemption applies until the waste is physically removed from the unit in which it was generated, unless the unit is a surface impoundment or unless the hazardous waste remains in the unit more than 90 days after the unit ceases to be operated for manufacturing, storage, or transportation of product or raw materials. Therefore, units such as product (not hazardous waste) distillation columns generating organic hazardous waste still bottoms are not subject to the RCRA process vent and equipment leak standards while the wastes are in the product distillation column or unit. However, distillation columns that treat such hazardous wastes (i.e., hazardous waste management units) are subject to these standards if located at a RCRA-permitted facility.

### 3.2.2 Totally Enclosed Treatment Units

Totally enclosed treatment facilities also are exempt from RCRA Subtitle C requirements under 40 CFR 264.1(g)(5), 40 CFR 265.1(c)(9), and 270.1(c) (2). A "totally enclosed treatment facility" is a hazardous waste treatment facility that is "directly connected to an industrial production process and which is constructed and operated in a manner that prevents the release of any hazardous waste or any constituent thereof into the environment during treatment" (40 CFR 260.10). Two important characteristics define a totally enclosed treatment facility. The key characteristic of a totally enclosed treatment facility is that it does not release any hazardous waste or constituent of hazardous waste into the environment during treatment. Thus, if a facility leaks, spills, or discharges waste or waste constituents, or emits waste or waste constituents into the air during treatment, it is not a totally enclosed treatment facility within the meaning of these regulations. The second important characteristic is that it must be directly connected to an industrial production process. Treatment facilities located off the site of generation, e.g., commercial TSDF, are not directly connected to an industrial process and therefore are not exempt. In addition, storage and disposal units and ancillary equipment not used to treat hazardous wastes fall outside the definition of a totally enclosed treatment facility.

The EPA believes that most on-site treatment facilities are not totally enclosed. Distillation columns and other treatment technologies generally are designed to release emissions into the air. Therefore, by definition, these on-site technologies are generally not totally enclosed. (See 45 FR 33218, May 19, 1980 [no constituents released to air during treatment].) Because of the precise definition, there should be no process vent emissions from units that are exempted as "totally enclosed treatment facilities."

### 3.2.3 Elementary Neutralization and Wastewater Treatment Units

Also excluded from these standards are elementary neutralization and wastewater treatment units as defined by 40 CFR 260.10. The EPA amended these definitions (see 53 FR 34080, September 2, 1988) to clarify that the scope of the exemptions applies to the tank systems, not just the tank. For example, if a wastewater treatment or elementary neutralization unit is not subject to RCRA Subtitle C hazardous waste management standards, neither is ancillary equipment connected to the exempted unit. The amendments also clarify that, in order for a wastewater treatment tank to be exempt, it must be part of an on-site wastewater treatment facility. Thus, equipment and process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations and ancillary equipment (piping, pumps, etc.) that are associated with a tank that is part of a wastewater treatment system subject to regulation either under Section 402 or 307(b) of the Clean Water Act (CWA) are not subject to these standards. However, EPA intends that air emission sources not subject to RCRA may be subject to Clean Air Act (CAA) guidance and/or standards.

### 3.2.4 Generator Accumulation Tanks

In 40 CFR 270, hazardous waste generators who accumulate waste on-site in containers or tanks for less than the time periods provided in Section 262.34 are specifically excluded from RCRA permitting requirements (i.e., a generator may accumulate hazardous waste on-site for 90 days or less without a RCRA permit or without having interim status). To qualify for the exclusions in Section 262.34, generators who accumulate hazardous waste on-site for up to 90 days must comply with 40 CFR 265, Subpart I or J (depending on whether the waste is accumulated in containers or tanks), and with other requirements specified in Section 262.34. Small-quantity generators (i.e., generators who generate more than 100 kg [222.2 lb] but fewer than 1,000 kg [2,222.2 lb] per calendar month) are allowed to accumulate waste on-site for up to 180 days or, if they must ship waste off-site for a distance of 200 miles or more and if they meet certain other requirements set out in Section 262.34, for up to 270 days.

The promulgated regulation for process vents and equipment leaks does not create a new exemption for 90-day accumulation, nor does it modify the existing regulation. The EPA is considering what changes (if any) should be made to Section 262.34 (the "90-day rule") under a separate rulemaking (51 FR 25487, July 14, 1986). As part of that effort, EPA currently is evaluating whether air emissions from these and other accumulator tanks at the generator site should be subject to additional control requirements. Preliminary analysis indicates that 90-day tanks and containers may have significant organic air emissions; consequently, as part of the second phase of TSDF air emission regulations, EPA intends to propose to modify the exemption to require that 90-day tanks meet the control requirements of the TSDF air standards. Until a final decision is made on regulating the emissions from these units, they will not be subject to additional controls under Subparts AA and BB.

### 3.2.5 Closed-loop Reclamation Units

The process vent and equipment leak rules regulate the activity of reclamation at certain types of RCRA facilities for the first time. The EPA has amended 40 CFR 261.6 under its RCRA authority over reclamation to allow covering reclamation of hazardous wastes in waste management units affected by these rules. It should be recognized, however, that the rules apply only at facilities otherwise needing a RCRA permit. In addition, the closed-loop reclamation exemption in Part 261.4(a)(8) is not changed by these rules. Therefore, not all reclamation units will necessarily be affected by the process vent and equipment leak rules.

In response to a court opinion (American Mining Congress v. EPA, 824 F.2d 1177, D.C. Circuit Court of Appeals, July 31, 1987, concerning the scope of EPA's RCRA authority), EPA proposed amendments to the RCRA definition of "solid waste" that would clarify when reclamation operations can be considered to be managing solid and hazardous wastes (53 FR 519, January 8, 1988). The EPA has accepted comments on its interpretation and proposed amendments. The EPA has not yet taken final action on this proposal. Thus, EPA is addressing the scope of its authority over reclamation operations under RCRA in the context of that rulemaking. The process vent and equipment rules are based on EPA's current interpretation of its RCRA authority, as described in the January 1988 proposal.

The following summarizes EPA's proposed position. In general, the proposed amendments would exclude from RCRA control only those spent solvents reclaimed as part of a continuous, ongoing manufacturing process where the material to be reclaimed is piped (or moved by a comparably closed means of conveyance) to a reclamation device, any storage preceding reclamation is in a tank, and the material is returned, after being reclaimed, to the original process where it was generated. (Other conditions on this exclusion relate to duration and purpose of the reclamation process. See proposed Section 261.4[a][8].)

However, processes (or other types of recycling) involving an element of "discard" are (or can be) within RCRA Subtitle C authority. When spent materials are being reclaimed, this element of discard can arise in two principal ways. First, when spent materials are reclaimed by someone other than the generator, normally in an off-site operation, the generator of the spent material is getting rid of the material and so is discarding it. In addition, the spent material itself, by definition, is used up and unfit for further direct use; the spent material must first be restored to a usable condition. Moreover, storage preceding such reclamation has been subject to the Part 264 and 265 standards since November 19, 1980. (See generally 53 FR 522 and underlying record materials.) The American Mining Congress opinion itself indicates that such materials are solid wastes (824 F.2d at 1187).

When a spent material is reclaimed on-site in something other than a closed-loop process, EPA also considers that the spent material is discarded (i.e., spent solvents removed from the process, transferred to an on-site distillation unit, and regenerated have been removed from the production process). The EPA's reasoning is that these materials are no longer available for use in an ongoing process and have been disposed from that operation, even if the reclamation operation is on-site. Finally, EPA also considers that when hazardous secondary materials are reclaimed but when burned as fuels, the entire operation--culminating in thermal combustion--constitutes discarding via destructive combustion (53 FR 523). Consequently, under this reading, any intermediate reclamation step in these types of fuel production operations remains within EPA's Subtitle C authority.

In summary, under EPA's current interpretation of the court's opinion, air emissions from distillation, fractionation, thin-film evaporation, solvent extraction, and stripping processes involving reclamation of spent solvent and other spent hazardous secondary materials can be regulated under RCRA Subtitle C whenever the reclamation system is not part of the type of closed-loop reclamation system described in proposed Part 261.4(a)(8). Any changes to this interpretation as part of the solid waste definition final rule may affect the scope of this rule.

### 3.2.6 Domestic Sewage Units

Under the "domestic sewage exclusion" (DSE) (specified in Section 1004[27] of RCRA and codified in 40 CFR 261.4[A][1]), solid or dissolved material in domestic sewage is not, by definition, a "solid waste" and, as a corollary, cannot be considered a "hazardous waste." Thus, the domestic sewage exclusion covers:

- "Untreated sanitary wastes that pass through a sewer system"
- "Any mixture of domestic sewage and other wastes that passes through a sewer system to a POTW for treatment" (40 CFR 261.4[A][1]).

The premise of the exclusion is that it is unnecessary to subject hazardous wastes mixed with domestic sewage to RCRA management requirements since these DES wastes receive the benefit of treatment offered by POTW and are already regulated under Clean Water Act programs such as the National Pretreatment Program.

The exclusion allows industries connected to POTW to discharge hazardous wastes to sewers containing domestic sewage without having to comply with certain RCRA generator requirements such as manifesting and reporting requirements. Moreover, POTW receiving excluded wastes are not deemed to have received hazardous wastes and, therefore, are not subject to RCRA treatment, storage, and disposal facility requirements.

### 3.2.7 Subtitle D Waste Management Units

Subtitle D wastes are all solid wastes regulated under RCRA not subject to hazardous waste regulations under Subtitle C. These wastes are defined in 40 CFR Part 257. In accordance with the above-mentioned definitions and exclusions, several categories of Subtitle D wastes have been identified. At least two of these waste categories, industrial nonhazardous waste and small-quantity generator waste, include wastes with significant amounts of organics.

Hazardous wastes generated by conditionally exempt small-quantity generators are solid wastes that are exempt, under 40 CFR 261.5, from Subtitle C regulations and thus are Subtitle D wastes. Conditionally exempt wastes are defined as those wastes that meet the definition of a hazardous waste under 40 CFR 261 and that are generated at a rate of less than 100 kg/month.

Detailed data on the types of facilities and process units that manage Subtitle D wastes are not available (with the exception of data on surface impoundments, landfills, land application units, and wastepiles); therefore, no characterization can be made regarding the type of process vents and their operating parameters for those waste treatment units managing Subtitle D wastes (such as industrial nonhazardous waste and conditionally exempt wastes).

## 3.3 DETERMINING APPLICABILITY

### 3.3.1 Applicability Examples

The following are scenarios where the final rule is and is not applicable:

1. Facility A is an off-site reclaimer of hazardous waste spent solvents by distillation.
    a. The spent solvents are stored in RCRA-permitted storage tanks before being reclaimed.

Facility A's distillation column and associated equipment would be subject to the rule (assuming the spent solvents or their derivatives contain greater than 10 ppmw organics). This is because Facility A's storage of spent solvent before distillation already requires a permit [40 CFR 261.6[c]].

b. The solvents are distilled without any prior storage.

Facility A's distillation activities are not subject to the process vent rules because the facility is not a TSDF and therefore is not required to obtain a RCRA permit. The EPA believes that this situation is unlikely to occur.

2. Facility B recycles hazardous waste spent solvents generated on-site.

a. The solvents are stored in tanks for a total of fewer than 90 days from time of generation, and the distilled spent solvents are piped back into the production process. There is no other hazardous waste management at the facility.

Facility B's distillation unit is not covered by Subparts AA and BB rules because 90-day accumulation tanks and containers are not covered by the rule, and Facility B is not required to obtain a storage permit (40 CFR 262.34).

b. The tank preceding distillation stores the solvents for more than 90 days.

Facility B's distillation unit is covered by the rule because Facility B already requires a storage permit. Note, however, that this type of configuration could potentially constitute an excluded closed-loop reclamation system if it meets conditions in 40 CFR 261.4(a)(8)(i)-(iv).

c. The facility also operates a surface impoundment managing a different hazardous waste.

Facility B's distillation of a hazardous waste is subject to the rule because the facility requires a permit for the impoundment.

d. The facility generates hazardous waste spent solvents and sends them to on-site distillation without prior storage.

The distillation activities are not subject to the rule because no TSDF is operating. They would be covered if Facility B had an independent unit requiring a RCRA permit, as in Example 2c.

3. Facility C operates a manufacturing process that distills organic-rich feedstocks and generates a distillation bottom that is a listed hazardous waste.

   The distillation column is not covered by the rule because it processes raw materials, not hazardous wastes. In addition, no storage permit is required for the still bottom while it is in the distillation column (40 CFR 261.4[c]). It should be noted that this facility would likely be covered under a CAA requirement (e.g., 40 CFR Part 60, Subpart VV).

### 3.3.2 Applicability Decision Tree

Figures 3-1 and 3-2 present decision trees that can be used to determine if a facility is required to comply with RCRA Parts 264 or 265, Subparts AA and/or BB.

## 3.4 APPLICABILITY CRITERIA

### 3.4.1 Process Vents

As noted above, a process vent associated with hazardous waste distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations that manage wastes with at least 10 ppmw total organics on a time-weighted annual average basis will be subject to the standards. The proposed 10-percent criterion for process vents was not included in the final rules because the standards contain a facility-based emission rate limit of 1.4 kg/h (3 lb/h) or 2.8 Mg/yr (3.1 ton/yr) that is more relevant for controlling emissions from affected sources and excluding facilities with little emission reduction potential. Based on the final emissions and health risk analyses, this emission rate limit represents an emission level from process vents that is protective of human health and the environment. In addition, modeling indicates that control of facilities with process vent emissions less than the emission rate limit does not result in further reductions of either cancer risk or incidence on a nationwide basis. Facilities with organic emissions from affected process vents that do not exceed these emission rates will not have to reduce their process vent emissions under the provisions of Subpart AA.

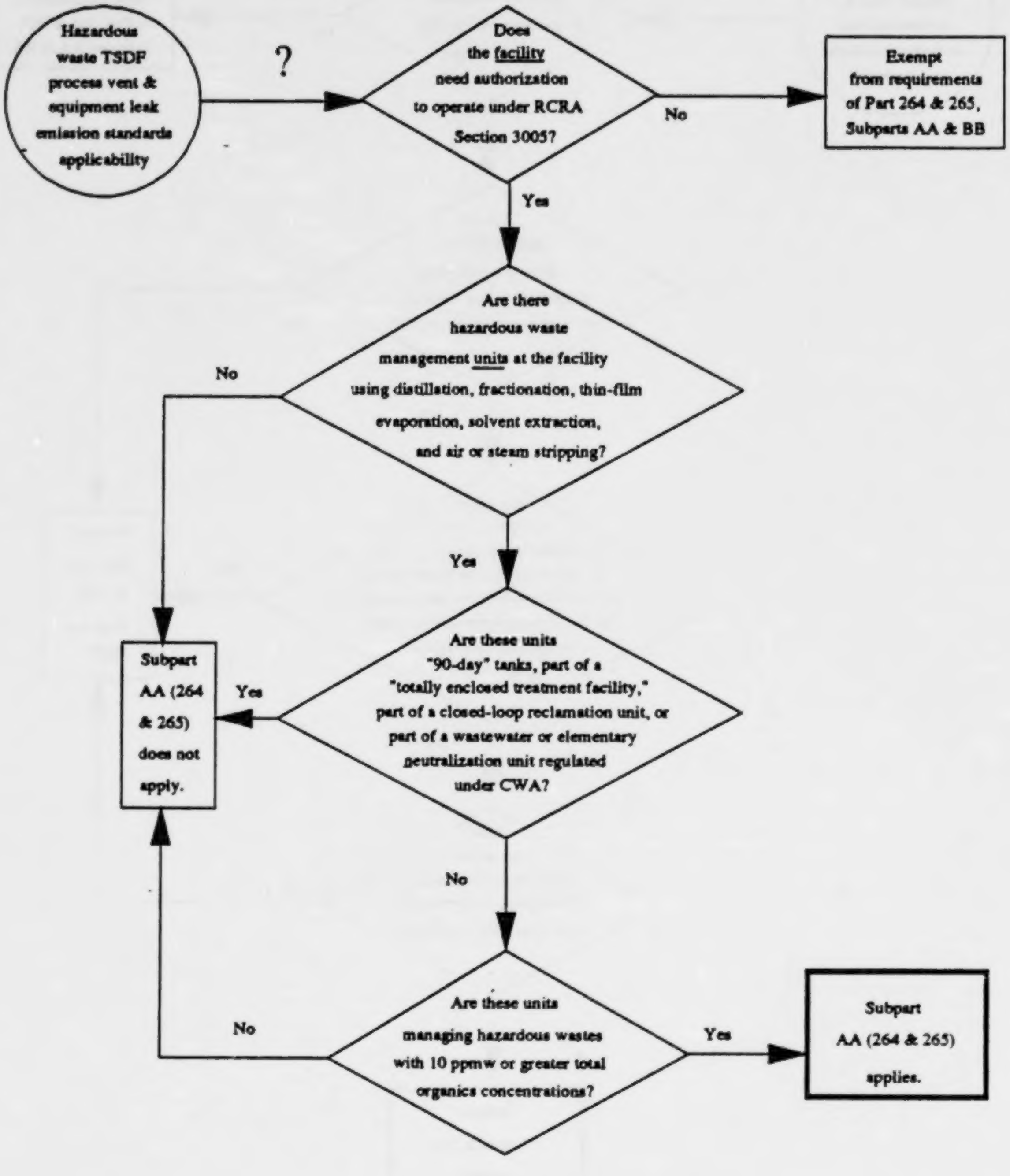
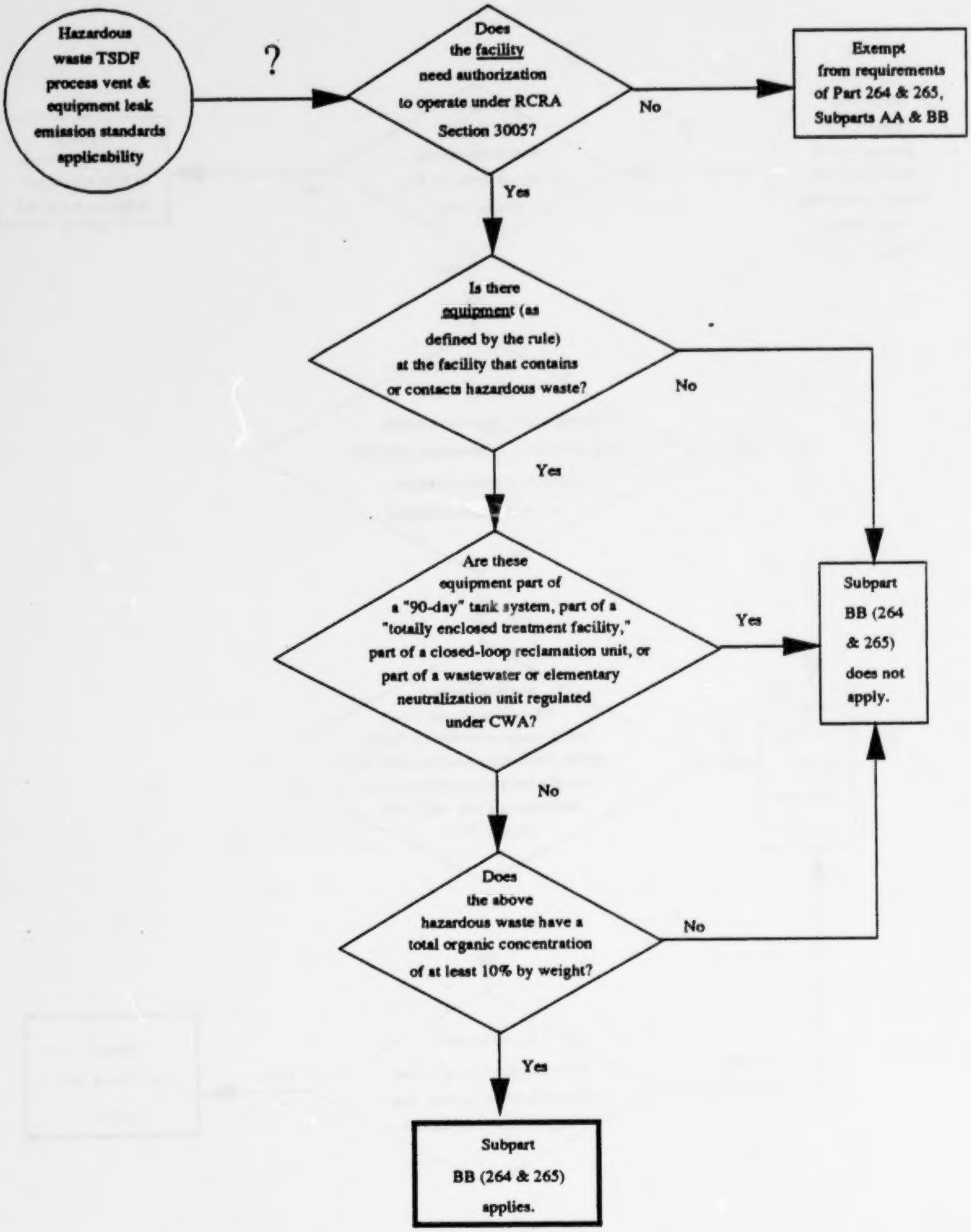

Hazardous waste TSDF process vent & equipment leak emission standards applicability
?
Does the facility need authorization to operate under RCRA Section 3005?
No
Exempt from requirements of Part 264 & 265, Subparts AA & BB
Yes
Are there hazardous waste management units at the facility using distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping?
No
Yes
Subpart AA (264 & 265) does not apply.
Yes
Are these units "90-day" tanks, part of a "totally enclosed treatment facility," part of a closed-loop reclamation unit, or part of a wastewater or elementary neutralization unit regulated under CWA?
No
No
Are these units managing hazardous wastes with 10 ppmw or greater total organics concentrations?
Yes
Subpart AA (264 & 265) applies.

Figure 3-1. Applicability decision tree for process vent rules (Subpart AA)



Hazardous waste TSDF process vent & equipment leak emission standards applicability
?
Does the facility need authorization to operate under RCRA Section 3005?
No
Exempt from requirements of Part 264 & 265, Subparts AA & BB
Yes
Is there equipment (as defined by the rule) at the facility that contains or contacts hazardous waste?
No
Yes
Are these equipment part of a "90-day" tank system, part of a "totally enclosed treatment facility," part of a closed-loop reclamation unit, or part of a wastewater or elementary neutralization unit regulated under CWA?
Yes
Subpart BB (264 & 265) does not apply.
No
Does the above hazardous waste have a total organic concentration of at least 10% by weight?
No
Yes
Subpart BB (264 & 265) applies.

Figure 3-2. Applicability decision tree for equipment leaks (Subpart BB)

To determine whether a particular waste managed in a hazardous waste management unit of the type specified in the rule (e.g., a steam stripping or air stripping unit) is subject to the provisions of Subpart AA of Parts 264 and 265, the owner/operator is required to conduct a determination of the waste's total organic concentration initially (by the effective date of the standards or when the waste is first managed by a waste management unit) and thereafter on a periodic basis (for continuously generated wastes).

A waste determination would only be necessary for Subpart AA applicability when an owner/operator manages the waste in a distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operation that is not controlled for organic process vent emissions. Waste determinations would not be necessary for wastes managed in (affected) units that are controlled for organic emissions to meet the substantive requirements of Subpart AA.

Determination that the time-weighted, annual average total organic concentration of the waste managed in the unit is less than 10 ppmw must be performed by direct measurement or by knowledge of the waste as described later in Chapter 6.0 of this document.

The final rules require that an owner/operator repeat the waste determination whenever there is a change in the waste being managed or a change in the process that generates or treats the waste or, if the waste and process remain constant, at least annually.

With the time-weighted, annual average applicability criterion, a hazardous waste management unit would not be subject to the process vent rule if it occasionally treats wastes that exceed 10 ppmw if at other times the wastes being treated in the unit were such that the weighted annual average total organic concentration of all wastes treated is less than 10 ppmw.

### 3.4.2 Equipment Leaks

A piece of equipment (e.g., pumps, valves, sampling connections) is subject to the standards if it contains or contacts hazardous waste with organic concentrations at least 10 percent by weight. An owner or operator of a facility must determine, for each piece of equipment, whether the equipment contains or contacts a hazardous waste with organic concentrations that will ever equal or exceed 10 percent by weight (Sections 264.1063[d] and 265.1063[d]). Test methods are incorporated by reference under Section 260.11[a] for determining the organic concentration of hazardous waste. For each method, the applicability to different waste matrices and the conversion of test results to the units of the standard are described in Chapter 6.0. An owner or operator alternatively may apply knowledge of the hazardous waste stream or the generation process to determine that the percent organic content of the hazardous waste clearly will never equal or exceed 10 percent by weight. If an owner or operator determines that a piece of equipment is handling waste with greater than 10 percent total organics by weight, then the equipment is subject to the Subpart BB requirements. The owner/operator must repeat the determination following the procedures in the applicable test methods referenced in the rules (Sections 264.1063 and 265.1063) to obtain an exception. If any action is taken that would result in the determination no longer being appropriate to the facility's or a particular unit's operation (e.g., an upstream process change that results in a change in the waste's organic content), then a new waste determination is required.

## 3.5 APPLICABILITY DISAGREEMENTS

Determining the applicability of the standards to hazardous waste management processes is of paramount importance to the TSDF owner or operator in complying with the final standards. A mistake, even an inadvertent one, will not excuse a facility owner or operator from the obligation to comply with either the requirements of the standards or potential enforcement actions. Accurate determinations of what equipment must be controlled are crucial to ensuring that all equipment subject to this rule is in fact controlled.

When the facility owner/operator and Regional Administrator disagree on whether a hazardous waste management unit manages a waste with 10 ppmw or greater organic content or a piece of equipment contains or contacts a waste with 10 percent or more organic content, then procedures that conform to the test methods referenced in the rules must be used to resolve the disagreement. In situations where the owner/operator and the Regional Administrator disagree on the determination of emissions or emission reduction achieved, then a performance test, conducted as specified in the rules, must be used to resolve the disagreement.

# 4.0 EQUIPMENT LEAKS

With the goal of reducing the potential adverse health effects of organic and toxic air emissions, the Subpart BB equipment leak standards limit organic emissions from process equipment or piping that handle hazardous waste streams with an organic content of 10 percent or more (by weight) at TSDF requiring authorization to operate under RCRA Section 3005. This chapter describes the various types of equipment and control techniques to limit organic emissions, presents equipment standards, discusses pumps and valves that could be designated for no detectable emissions, provides emission factors for estimating uncontrolled fugitive emissions from process equipment at TSDF, and provides information on repair methods for leaking pumps and valves.

## 4.1 TYPES OF EQUIPMENT

TSDF have numerous potential sources of equipment leak fugitive emissions. This section provides a brief description of each type of equipment and associated potential emission sources to assist the permit writer/reviewer and facility owner/operator in identifying equipment affected by the regulation. The following types of equipment are discussed: valves, pumps, compressors, flanges, pressure relief devices, sampling connection systems, and open-ended valves or lines.

### 4.1.1 Pumps

Pumps are integral pieces of equipment to most hazardous waste management processes, transporting liquid and sludge wastes throughout a facility. Pumps may be classified on the basis by which energy is added to the fluid and may be divided into two major categories: (1) dynamic, in which energy is continuously added to increase the fluid velocities, and (2) displacement, in which energy is periodically added by application of force to one or more movable boundaries.

Dynamic pumps may be further subdivided into several varieties of centrifugal and other special-effect pumps. Figure 4-1 presents in outline form a summary of the significant classifications and subclassifications of dynamic pumps.

Similarly, displacement pumps may be classified into reciprocating and rotary types, depending on the nature of movement of the pressure-producing members. Each of these major classifications may be further subdivided into several specific types, as indicated in Figure 4-2.

#### 4.1.1.1 Dynamic Pumps.

#### Centrifugal Pumps

The centrifugal pump is the type most widely used in the chemical industry for transferring liquids of all types--raw materials, materials in manufacture, and finished products--as well as for general services of water supply, boiler feed, condenser circulation, condensate return, etc.[1] Centrifugal pumps are available in a vast range of sizes in capacities from 2 or 3 gal/min up to 100,000 gal/min and for discharge heads (pressures from a few feet up to several thousand pounds per square inch). The size and type best suited to a particular application can be determined only by an engineering study of the problem and its requirements.

The primary advantages of a centrifugal pump are simplicity, low initial cost, uniform (nonpulsating) flow, small floor space requirements, low maintenance expense, quiet operation, and adaptability to use with motor or turbine drive.

A simple centrifugal pump consists of an impeller rotating within a casing (see Figure 4-3). The impeller consists of a number of blades, either open or shrouded, mounted on a shaft that projects outside the casing. Impellers may have their axis of rotation either horizontal or vertical to suit the work to be done. Closed-type or shrouded impellers are generally most efficient and are almost universally used in centrifugal pumps handling clear liquids. Generally, open- or semiopen-type impellers are used in small, inexpensive pumps or pumps handling abrasive liquids and high viscosity liquids. Impellers may be of the single-suction type or double-suction type--single if the liquid enters from one side, double if it enters from both sides.

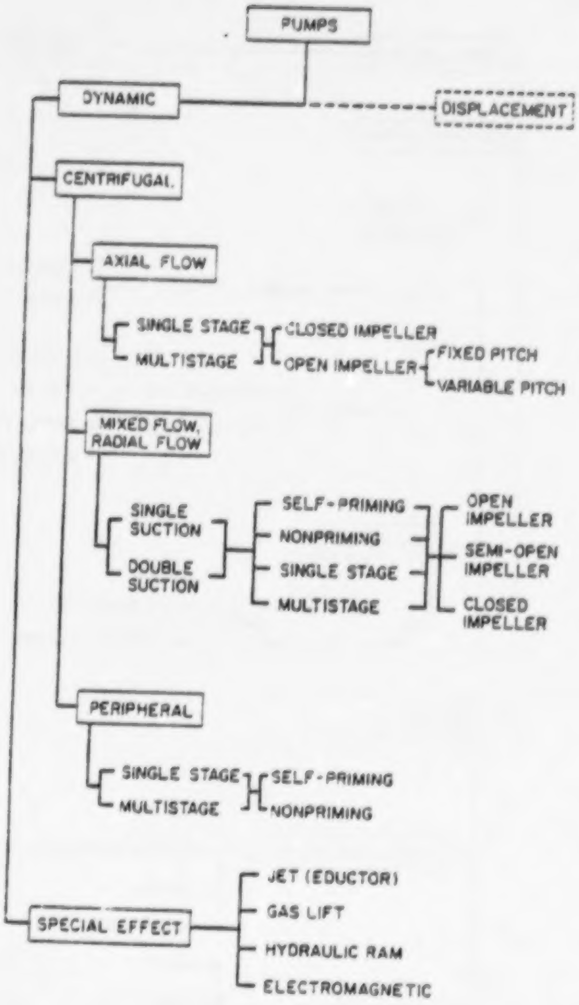


Figure 4-1. Classification of dynamic pumps.

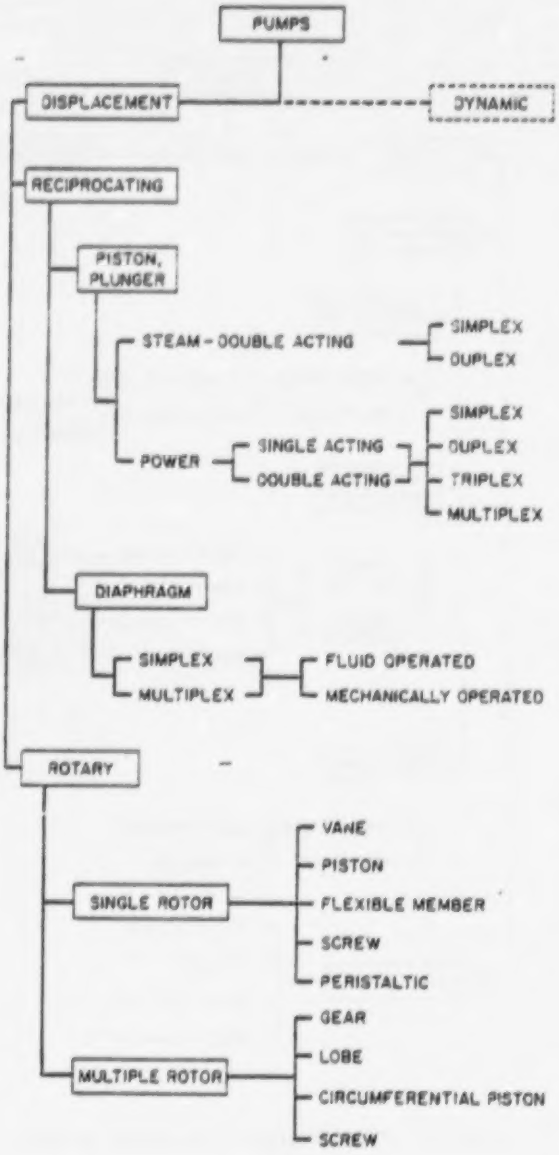


Figure 4-2. Classification of displacement pumps.

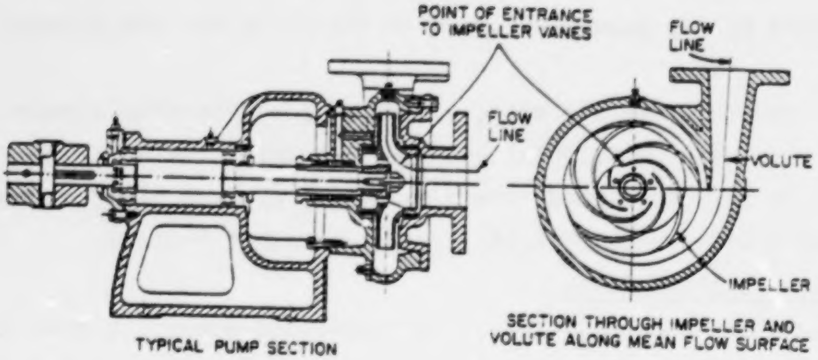

POINT OF ENTRANCE TO IMPELLER VANES
FLOW LINE
FLOW LINE
VOLUTE
IMPELLER
TYPICAL PUMP SECTION
SECTION THROUGH IMPELLER AND VOLUTE ALONG MEAN FLOW SURFACE

**Figure 4-3. Centrifugal pump construction.**

The canned-motor pump, a special type of centrifugal pump as shown in Figure 4-4, is widely used in the chemical industry. Canned-motor pumps are described in Section 4.1.3.

4.1.1.2 Displacement Pumps. The total dynamic head developed by a centrifugal, mixed-flow, or axial-flow pump is uniquely determined for any given flow by the speed at which it rotates. Positive-displacement pumps and those that approach positive displacement will ideally produce whatever head is impressed upon them by the restrictions to flow on the discharge side. Actually, neglecting slippage, the maximum head attainable is determined by the power available in the drive and the strength of the pump parts.

In general, overall efficiencies of positive-displacement pumps are higher than with centrifugal equipment because internal losses are minimized. On the other hand, the flexibility of each piece of equipment in handling a wide range of capacities is somewhat limited.

Reciprocating Pumps

There are three classes of reciprocating pumps: piston pumps, plunger pumps, and diaphragm pumps. Reciprocating pumps work on the principle of a reversing piston motion within a cylinder drawing in fluid on the ingoing stroke and delivering it under pressure on the outgoing stroke. To do this they require one-way valves (or equivalent piston-swept ports) on both the suction and delivery sides.

A variety of configurations are possible depending on the mechanical system used to derive the reciprocating piston motion; the number of cylinders; the valving system; etc. The terms "piston" and "plunger" are often used interchangeably by users and occasionally lead to confusion in communications. A piston, as shown in Figure 4-5, is a cylindrical disk mounted on a smaller-diameter rod and usually fitted with some type of sealing ring. The rings move with the piston. A plunger, as shown in Figure 4-6, is a smooth rod similar to a piston rod.[2] The sealing rings are stationary, and the plunger slides through the rings. A diaphragm is a flexible disk or tube, as shown in Figure 4-7, that serves to isolate the pumpage (the pumped fluid) from the piston, plunger, or atmosphere. Therefore, a diaphragm pump may be designated for no detectable emissions under the provisions of Sections 264.1052(e) and 265.1052(e). A diaphragm

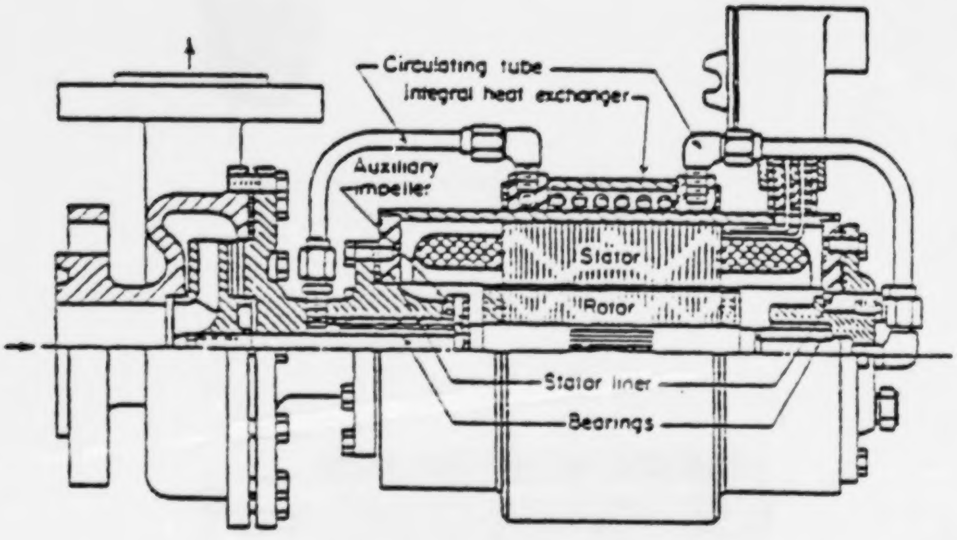


Figure 4-4. Chempump canned-motor pump.

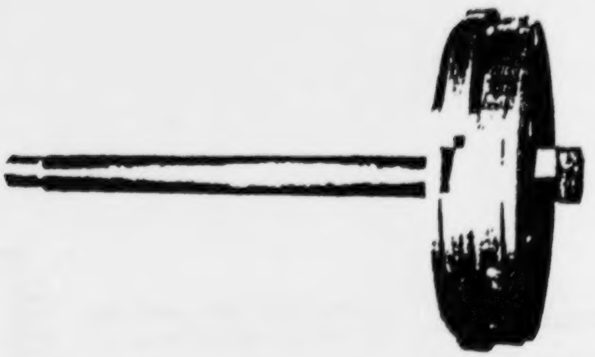
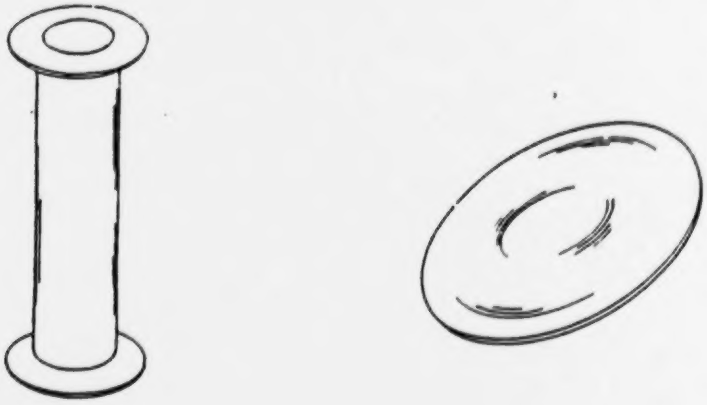


Figure 4-5. A piston mounted on a rod. (Courtesy Union Pump Co.).

Figure 4-6. A plunger. (Courtesy Union Pump Co.)



TUBULAR DIAPHRAGM　　DISC DIAPHRAGM

Figure 4-7. Two types of diaphragms used in Reciprocating pumps.

may be mechanically actuated (connected directly to a reciprocating rod) or hydraulically actuated (driven by liquid that is oscillated by a piston or plunger). Additional information on the diaphragm pump can be found in Section 4.1.3, "Sealless Pumps."

### Rotary Pumps

The main pumping action of rotary pumps is caused by relative movement between the stationary and rotating elements of the pump. These pumps are distinguished from reciprocating positive-displacement pumps in which the main motion of the moving elements is reciprocating rather than rotary. Rotary pumps are distinguished from centrifugal pumps in which liquid displacement and pumping action depend on liquid velocity by the positive-displacement nature of the pumping action of rotary pumps.

As a positive-displacement pump, the amount of liquid displaced by each revolution of a rotary pump is independent of speed. In addition, a time-continuous liquid seal is maintained between the outlet and inlet ports by the action and position of the pumping elements and the close clearances of the pump. Rotary pumps will handle any liquid that does not contain grit or abrasive material when constructed of proper materials.

Rotary pumps are available in two general classes: interior bearing and exterior bearing. The interior-bearing type is used for handling liquids of a lubricating nature, and the exterior-bearing type is used with nonlubricating liquids. The interior-bearing pump is lubricated by the liquid being pumped, and the exterior-bearing type is oil-lubricated.

One of the major types of rotary pumps is the gear pump. Gear pumps have two or more impellers in a rotary-pump casing; the impellers will take the form of toothed-gear wheels (as in Figure 4-8), helical gears, or lobed cams. In each case, these impellers rotate with extremely small clearance between each other and between the surface of the impeller and the casing. Referring to Figure 4-8, the two toothed impellers rotate as indicated by the arrows. The suction connection is at the bottom. As the spaces between the teeth of the impeller pass the suction opening, liquid is impounded between them, carried around the casing to the discharge opening, and then forced out through this opening. The flow of liquid is indicated by the arrows.

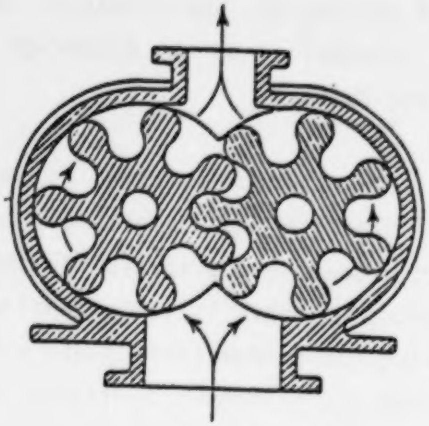


Figure 4-8. Gear-type rotary pump having two impellers.[3]

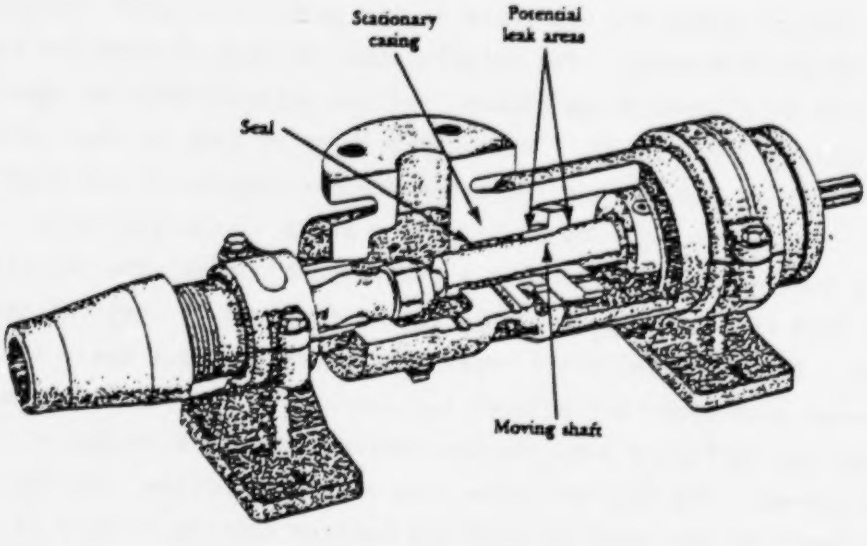


Figure 4-9. Horizontal screw pump.

The use of straight teeth in gear pumps will produce pulsations in the discharge having a frequency equivalent to the number of teeth on both gears multiplied by the speed of rotation. The amplitude of these disturbances is a function of the tooth design. This pulsation can be eliminated by the use of rotors having helical teeth with a suitable angle. This in turn introduces end thrust that, if excessive, can be balanced by the use of double helical or herring-bone teeth.

Another major type of rotary pump is the screw pump. Screw pumps fall into three distinct categories: single screw pumps (Archimedean screws), rigid screw pumps, and eccentric screw pumps (progressive cavity pumps).

The progressive cavity pump is very versatile and can handle a variety of liquids with a high efficiency.[4] It consists of a rigid screw-form rotor rolling in a resilient internal helical strator of hard or soft rubber with a moderately eccentric motion (see Figure 4-9). The progressive cavity pump can be specifically tailored to handle slurries, pastes, solids, and viscous liquids. These applications are suitable largely because of the low flow velocities realized through the pump.

### 4.1.2 Potential Leak Sources in Pumps

Leakage of hazardous waste fluid to the atmosphere can occur where the moving pump shaft meets the stationary casing. To minimize such leakage, two sealing techniques are commonly applied: packed seals and mechanical seals.

#### Packed Seals

Packed seals consist of a "stuffing box" in the pump casing. Specially selected packing materials (chosen on the basis of the process materials and environment) are compressed into the stuffing box with a packing gland, resulting in a tight seal around the shaft. Because the shaft must move, either rotationally or laterally, lubrication must be supplied to the packing and shaft to prevent excessive heat generation from the friction between the shaft and packing, which could shorten the life of the equipment. Leaks may result from the degradation of the packing.

Leaks from packed seals can often be reduced by tightening the packing gland. But at some point the packing will have deteriorated to the extent that it must be replaced. Often, pump packing can be replaced only when the pump is out of service.

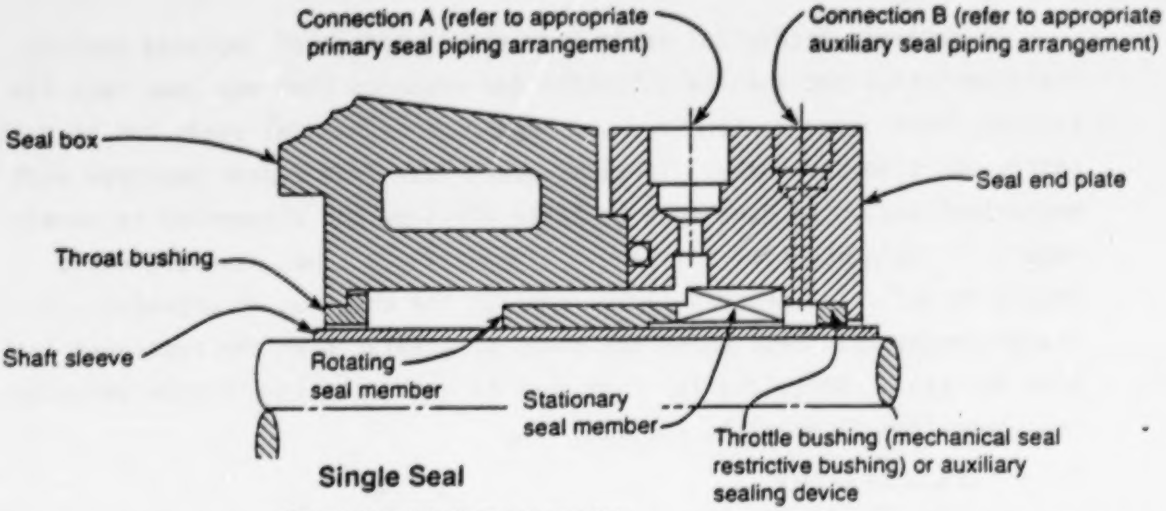
### Mechanical Seals

Single and dual mechanical seals are used to seal pumps with rotating shafts. Both have the common attribute of a lapped seal face between a stationary element and a rotating seal ring. Although mechanical seals are not leakless sealing devices, the leakage of organic emissions from the seal can be minimized by a properly installed and operated mechanical seal.

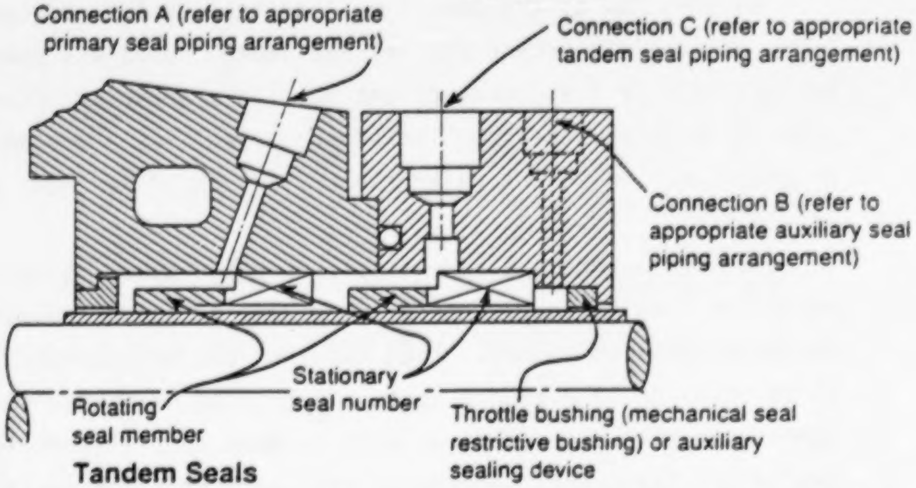
Because a mechanical seal will leak (unless routinely replaced), the ultimate potential for leakage can be reduced through redundancy of sealing mechanisms. For instance, a single seal may employ a packed seal as an auxiliary sealing mechanism to reduce fugitive emissions. Or the same purpose might be just as easily accomplished with a dual mechanical seal arrangement (either back-to-back or tandem). As shown in Figure 4-10, the dual mechanical seals in both arrangements form a cavity.

In the back-to-back arrangement, a barrier fluid circulates between the two seals. With the barrier fluid pressure maintained above the pump's operating pressure, any leakage is across the inboard seal face into the hazardous waste stream fluid and across the outboard seal face to the atmosphere. The tandem arrangement basically has a single seal backed up by another single seal; both seals are mounted facing the same direction.

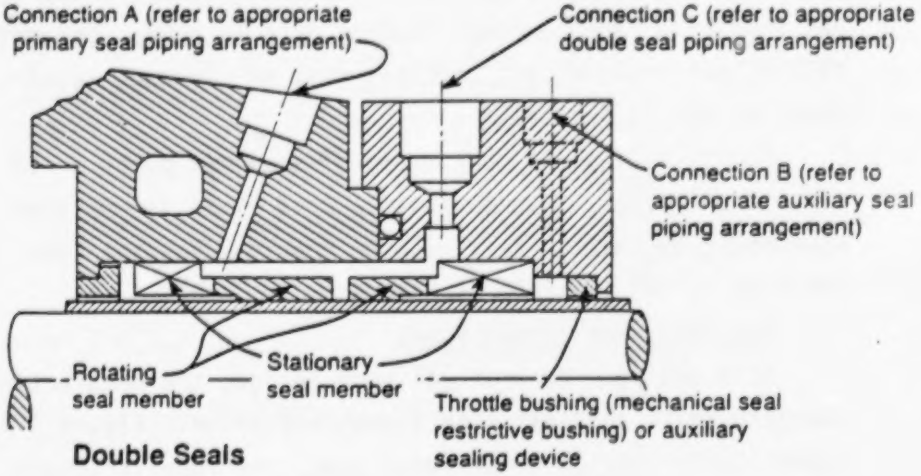
The seal fluid (also referred to as the buffer or barrier fluid) is circulated through the space between the seals. Any hazardous waste stream fluids that may leak into the barrier fluid across the inboard seal interface may be removed with the barrier fluid or degassed in a reservoir. The degassed materials could then be treated in a control system. Barrier fluid degassing is not necessary if the pump is equipped with a system that purges the barrier fluid into a hazardous waste stream with zero total organic emissions to the atmosphere (Sections 264.1052[d][1][iii] and 265.1052[d][1][iii]) or if the pressure of the barrier fluid is maintained at a level higher than the pump fluid pressure; this results in the leakage entering the pumped fluid rather than the barrier fluid.


Connection A (refer to appropriate primary seal piping arrangement)
Connection B (refer to appropriate auxiliary seal piping arrangement)
Seal box
Seal end plate
Throat bushing
Shaft sleeve
Rotating seal member
Stationary seal member
Throttle bushing (mechanical seal restrictive bushing) or auxiliary sealing device

**Single Seal**


Connection A (refer to appropriate primary seal piping arrangement)
Connection C (refer to appropriate tandem seal piping arrangement)
Connection B (refer to appropriate auxiliary seal piping arrangement)
Stationary seal number
Rotating seal member
Throttle bushing (mechanical seal restrictive bushing) or auxiliary sealing device

**Tandem Seals**


Connection A (refer to appropriate primary seal piping arrangement)
Connection C (refer to appropriate double seal piping arrangement)
Connection B (refer to appropriate auxiliary seal piping arrangement)
Rotating seal member
Stationary seal member
Throttle bushing (mechanical seal restrictive bushing) or auxiliary sealing device

**Double Seals**

NOTE: These illustrations are typical and do not constitute any specific design.

**Figure 4-10. Typical mechanical seal arrangements.**

In general, mechanical seals have the advantage of improved sealing characteristics and auxiliary control for organics that may leak into the barrier fluid system. However, the repair of mechanical seals can be both costly and time-consuming. To eliminate a leak from a pump equipped with a mechanical seal, the pump must be taken off-line and dismantled to permit repair or replacement of the seal. Dismantling a pump, however, could result in spills of process fluid, causing the emission of organics. Although temporary, these emissions could be greater than the continued leak from the seal. Additionally, care must be exercised to minimize emissions resulting from dismantling the pump.

### 4.1.3 Sealless Pumps

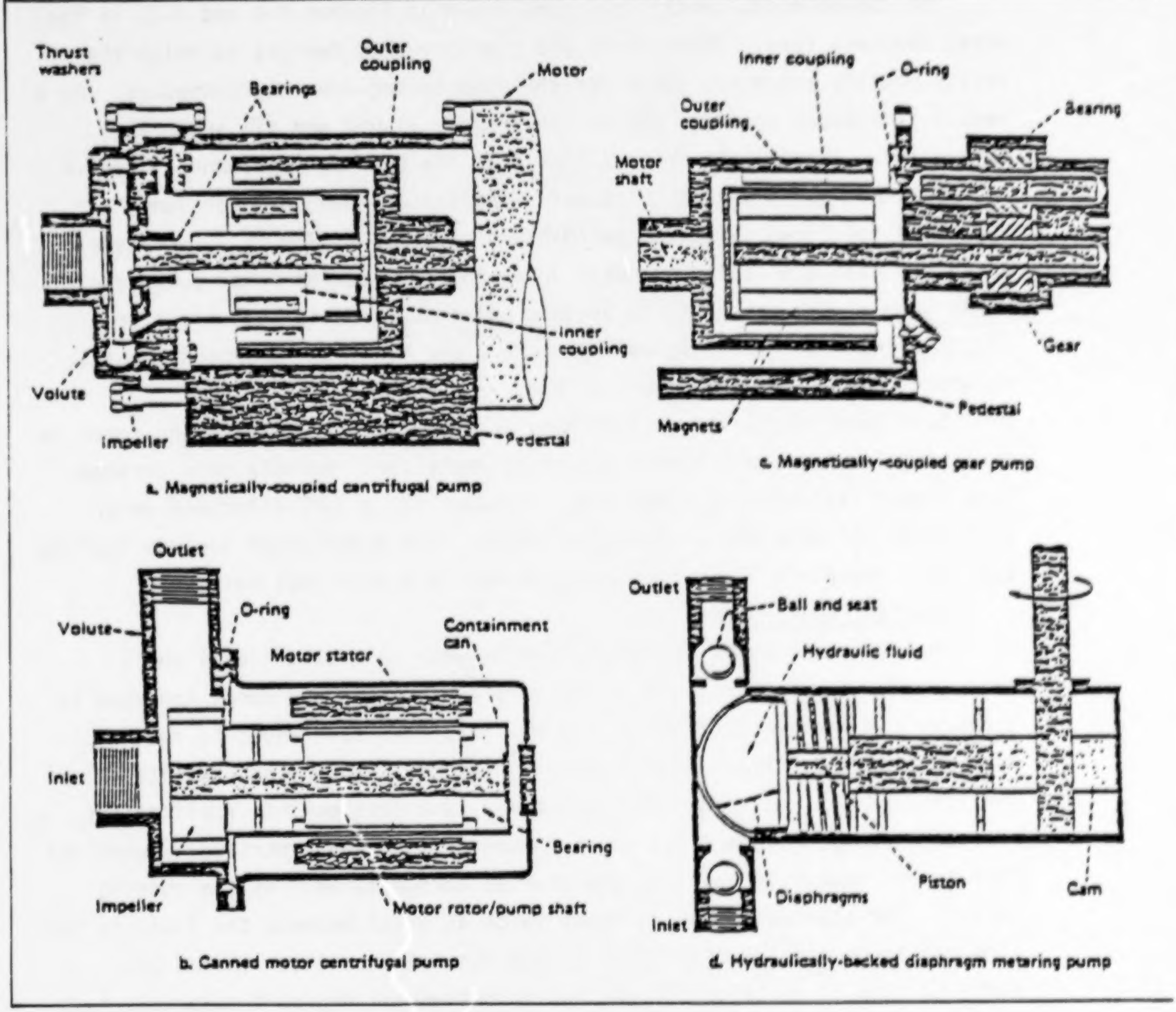
In addition to the pump types and seal designs discussed above, several types of sealless technology are available. Sealless pumps are designed not to leak at all; i.e., they do not have an externally actuated shaft penetrating the pump housing. Therefore, a sealless pump can be designated for no detectable emissions under the provisions of Sections 264.1052(e) and 265.1052(e).

Sealless pumps are very widely used for handling toxic, noxious, and explosive liquids, e.g., acids, bleaches, poisonous solvents, and active pharmaceutical compounds. They require less maintenance than sealed pumps, which saves on maintenance costs and reduces downtime. However, sealless pumps generally cost twice as much or more initially as sealed pumps. By and large, the overall economics will vary from one application to another and should be based on many factors such as power consumption; initial cost; cost of maintenance; and probable cost of cleanup, repair, and unplanned downtime due to failure.

Figure 4-11 shows four types of sealless pumps.[5] In the gear and centrifugal types, note that the pumped fluid is isolated from the atmosphere by solid metal. In the double-diaphragm type, the isolation is achieved by two flexible membranes.

#### Sealless Centrifugal Pumps

In a sealless centrifugal pump design, the manufacturer replaces the standard shaft and seal with a sealless drive. Figure 4-11 shows a magnetically coupled centrifugal pump; the impeller shaft, surrounded by magnets, is supported on bearings within a metal containment can. Outside



a. Magnetically-coupled centrifugal pump

c. Magnetically-coupled gear pump

b. Canned motor centrifugal pump

d. Hydraulically-backed diaphragm metering pump

Figure 4-11. Sealless pumps use magnetic couplings, canned motors, or diaphragms to isolate pumped liquid below from atmosphere.

the can is another set of magnets attached to the motor shaft. As the motor turns the outer coupling, magnetic attraction forces the inner coupling, and thus the shaft and impeller, to turn also.

The canned-motor centrifugal pump shown in Figures 4-4 and 4-11 is the other sealless type. These units are close-coupled designs in which the cavity housing the motor rotor and the pump casing are interconnected. As a result, the motor bearings run in the process liquid and all seals are eliminated. Because the process liquid is the bearing lubricant, abrasive solids cannot be tolerated. Standard single-stage canned-motor pumps are available for flows up to 700 gal/min and heads up to 250 ft. Two-stage units are also available for heads up to 600 ft. Canned-motor pumps are being widely used for handling organic solvents, organic heat-transfer liquids, and light oils, as well as many clean toxic or hazardous liquids, or where leakage is an economic problem.

Such pumps are built by machining an electric-motor stator and rotor to make room for the shaft sleeve and containment can. Because this arrangement alters the standard dimensions, it makes for a less efficient motor that gives off more heat. For this reason, such pumps often include cooling systems. Magnetically coupled pumps do not have such heat buildup.

### Sealless Gear Pumps

Sealless gear pumps are more prone to wear than centrifugal pumps because they have internal seals and more bearings. Such pumps are used to transfer and circulate difficult fluids--they have been known to run for more than a year without maintenance in hydrogen peroxide and sulfite service--and for high-head, high-viscosity, and suction-lift applications.

Gear pumps (Figure 4-11) require more torque than centrifugal pumps and have to be capable of handling the startup torque as well as the running torque. The startup torque is about twice as great because the fluid in the line has to be accelerated. Such torque requirements once limited gear pumps to capacities below 10 gpm, but more powerful magnetic materials have extended capacities to 50 gpm or more.

### Diaphragm Pumps

These pumps never have seals; the design does not require them. Moreover, they are generally selected not for their sealless design but for their ability to meter precisely and to handle abrasives, slurries, and highly viscous liquids. Because diaphragm pumps (Figure 4-11) have a pulsing action, they cannot be used in applications that demand steady flow. And because they are less efficient than centrifugal or rotary pumps, they are used mainly for fluids that other pumps cannot handle.

### 4.1.4 Valves

The valve is a common element found in most TSDF serving to regulate the flow of fluids as well as to isolate piping or equipment for maintenance. There are four basic valve types: globe, plug (plug valves can be further subdivided into three categories: conical, ball, and butterfly), gate, and diaphragm. These valve types are all constructed based on two basic principles: dutchboy (closing the pipe end) or tourniquet (squeezing the pipe, if it is flexible). The first principle is developed in three ways: (1) moving the stopper by direct thrust onto the orifice seating (the basis of globe-type valves), (2) rotating the stopper (the basis for plug-type valves), or (3) sliding the stopper across the face of the orifice seating (the basis of gate-type valves). The second principle, squeezing action, is the basis of all diaphragm-type valves. Each valve type has its own individual characteristics and its own advantages or disadvantages. Therefore, many variations of the basic types are made by valve manufacturers for a wide variety of applications. Table 4-1 provides a summary of the four basic valve types.

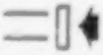
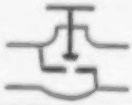
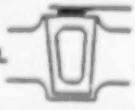
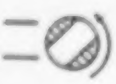
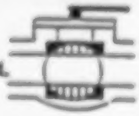
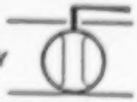
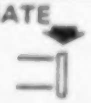
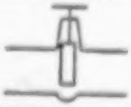
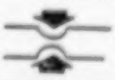
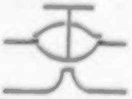
#### Gate Valves

Flow is straight through in the gate valve. It is opened by raising its "gate" (more commonly referred to as a disk or wedge) up and out of the flowpath. As the valve begins to open, the area of the flowpath changes very rapidly and nonlinearly. Flow in a partially opened valve occurs around the bottom and edges of the gate. Even fairly short periods of operation in this mode can cause damage to the valve by erosion and disk vibration.

There are several basic types of gate valves. The most common by far in process service is the wedge gate in which two seats sit at a slight angle to the vertical. In the closed position, the gate seals against both seats.

There are many variations of the basic design, such as the solid, flexible, or split (double-disk) wedge; inside or outside screw stem; rising or

## TABLE 4-1. FOUR BASIC VALVE TYPES

| | | ADVANTAGES | DISADVANTAGES |
|---|---|---|---|
| **GLOBE**<br>1  |  | Best shut-off and regulating characteristics | High head loss |
| **PLUG**<br>CONICAL |  | Quick acting.<br>Straight through flow | Temperature limitations on PTFE sleeved valves and need for attention to 'lubricant' in lubricated valves |
| 2  BALL |  | Quick acting.<br>Straight through flow.<br>Easy operation | Temperature limited by seating material |
| BUTTERFLY |  | Quick acting.<br>Good regulating characteristics<br>Compact | Metal to metal seated type does not give tight shut-off.<br>Temperature limited by seating material on resilient seated type |
| **GATE**<br>3  |  | Straight through flow | Slow acting.<br>Bulky |
| **DIAPHRAGM**<br>4  |  | Glandless.<br>Positive shut-off on dirty fluids | Pressure and temperature limited by diaphragm material |

nonrising stem; screwed, union, welded, bolted, or pressure-seal bonnet joint; screwed or bolted packing gland; threaded, seal-welded, pressed, or integral seat rings; handwheel, gear operator, or lever; screwed, socket-welded, flanged butt-welded, grooved, or clamp end; and numerous other variations (Figure 4-12). The classic steel gate valve is one having flanged ends, bolted bonnet, rising stem, outside screw and yoke (stem bushing support), handwheel operator, solid wedge, with hard-faced seat rings.

Globe Valves

By far the most common type of throttling valve in process service is the globe valve. Other types, such as the angle, needle, and Y-pattern valves, represent little more than variations on the same operating principle (Figure 4-13).

This valve gets its name from its shape. It differs from a gate valve in that the disk moves directly away from, not across, the seat when it is opened. This requires that the seat be concentric with the stem, which places it at right angles to the flowpath. This causes the flowstream to make two right-angle turns, which generates a pressure drop quite a bit higher than that produced by the gate valve. Because the flow area changes linearly with the stem movement, and the flowpath (as the disk begins to lift off the seat) is fairly streamlined, this valve is ideal for control applications.

Differently shaped disks can produce different control characteristics. The most common disk is the plug type with a conical seating surface (Figure 4-13). Others include the ball-type disk with a spherical seating surface. Used for handling viscous fluids, it is slightly less likely to bind in the seat. The V-port disk gives very fine control at low flow rates. Smaller seat diameters provide fine throttling at low flow rates.

The globe valve can seat much tighter than a gate valve under average operating conditions. This is important in high-pressure service and in handling a very light gas (such as hydrogen), and it is possible because the force applied to the stem is transmitted directly as a seating force, rather than as the wedging action in a gate valve.

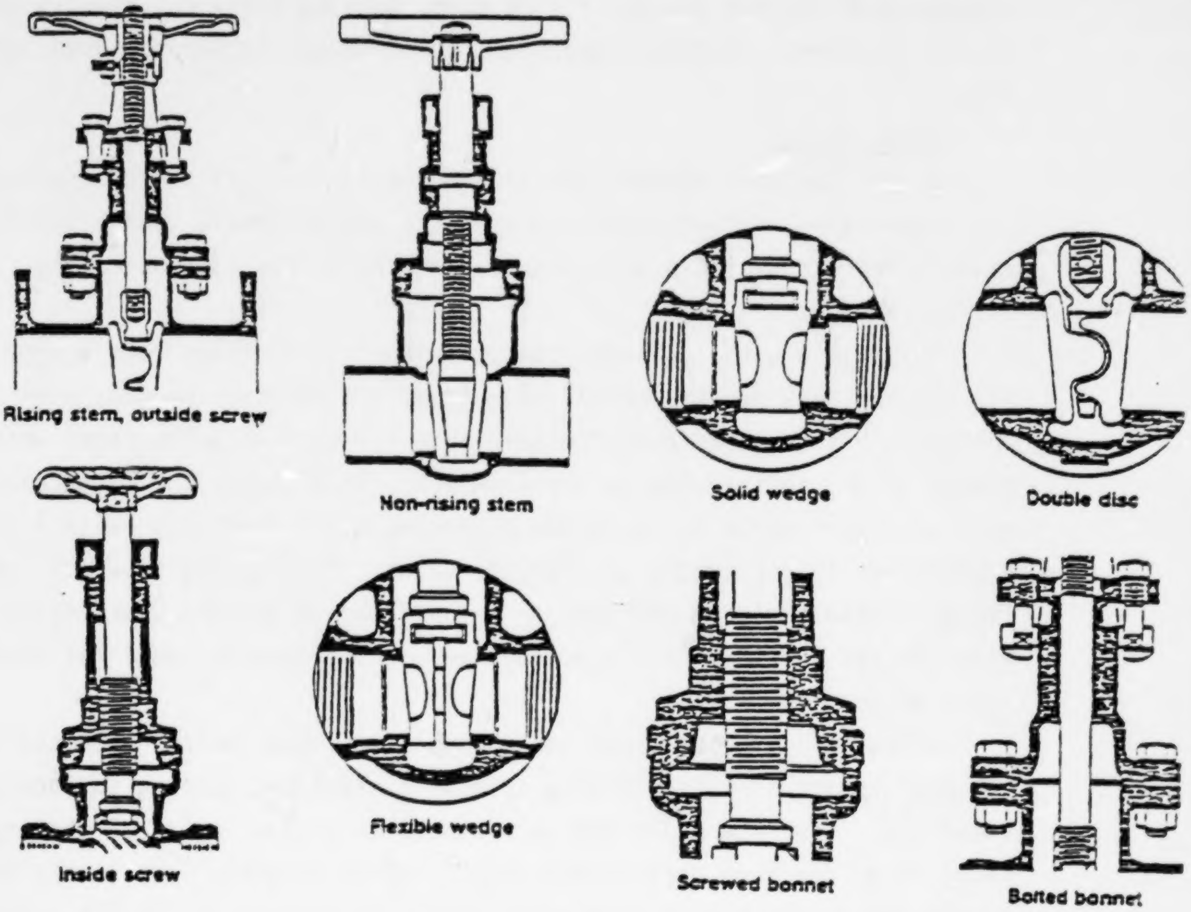
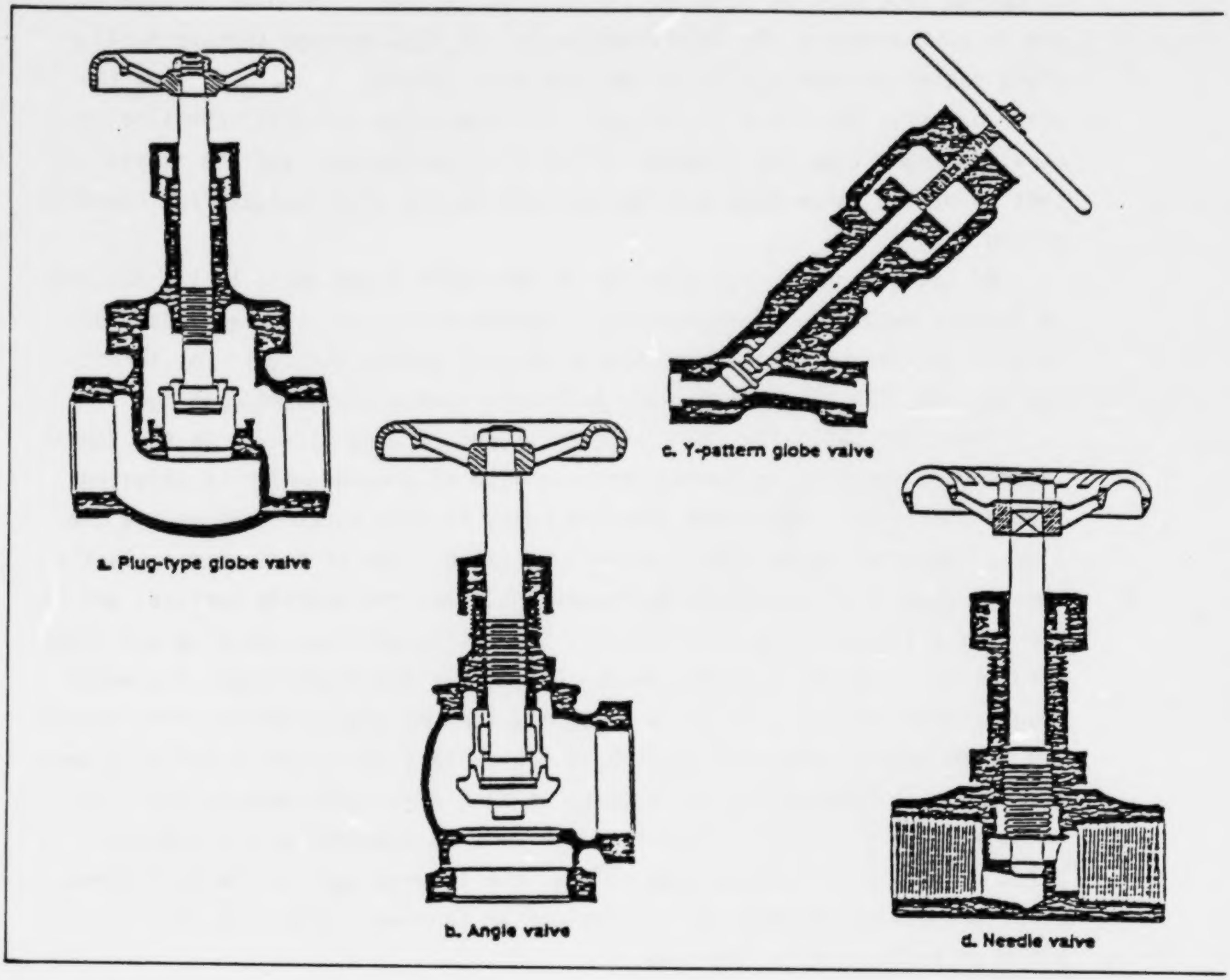


Figure 4-12. Some variations in gate-valve stems, discs and bonnets.



a. Plug-type globe valve

b. Angle valve

c. Y-pattern globe valve

d. Needle valve

Figure 4-13. Standard globe valve is: (a) plug-type with inside screw; variations include: (b) angle valve, (c) Y-pattern and (d) needle valve.

### Plug Valves

Also basically a straight-through design, this valve's "plug" is inserted into the flow passage. The valve is a quarter-turn valve; i.e., it is opened or closed by rotating the plug 90 degrees. The plug is tapered and is approximately the same diameter as the flow passage (Figure 4-14). Fluid passes through a slot in the plug that usually is narrower than the other parts of the fluid passageway. To compensate for this, the slot is usually longer than the diameter of the flow passageway, and the cross-section of the valve body opening approaching the plug changes from round to oblong.

By special order, the plug can be made with round holes in it, but this is usually much more expensive than standard plugs and is only needed for erosive service or when large objects must be passed through. For throttling service, the plug can be made with a horizontal V-shaped opening.

There are basically four different types of plug valves. In the lubricated type, the plug is surrounded by a film of grease, which is injected from the outside. Hydraulic pressure keeps foreign matter from behind the plug. The other three types are nonlubricated. One of these has a plastic sleeve, usually of polytetrafluoroethylene, over the bearing surface, and is known as a sleeved plug. In another, the entire waterway and plug are lined with plastic (or the plug may be all plastic). The fourth type, the wedge plug, is operated by lifting an inversely tapered plug slightly, then rotating it 90 degrees and setting it back down. This action pulls the plug away from a seal component (called a slip) at each port, then reseats the slips to give a tight shutoff. This type can also be designed as a block-and-bleed valve. Of all these plug valves, the sleeved type is the most common. Each type can be designed as a three-way or four-way valve, but only in a plane perpendicular to the stem.

### Ball Valves

The ball valve, which basically evolved from the plug valve, is also a quarter-turn valve, but with a spherical closure device. The opening in the ball is invariably round, but usually not of the same diameter as the flow passage.

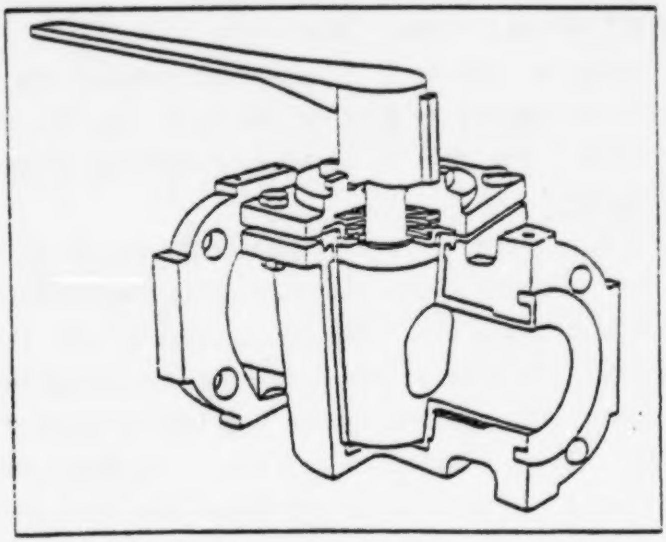


**Figure 4-14. Plug valve can be closed with a quarter turn of the handle.**

Ball valves are capable of somewhat limited throttling. They can be built as three-, four-, five-, and even six-way designs with almost any combination of flow patterns, including into the bottom of the valve. Multiple-port valves (in which one port is shut off before another is opened) are larger and more expensive than those in which one port is opened before the previously open one is closed because more radial separation must be provided.

Ball valves are manufactured in varying degrees of sophistication, ranging from throwaway brass valves having rubber seals to high-performance metal-seated valves designed for handling high-pressure, 1,000 °F (537.7 °C) abrasive catalyst or coke fines. Most conventional ball valves have a floating ball; that is, the ball is suspended between the two seats. Line pressure assists in sealing by pushing the ball into the downstream seat. In the larger valves, the ball is normally supported by trunnions.

### Butterfly Valves

There are two different types of butterfly valves (Figure 4-15). One is the so-called "rubber-lined" valve, which is the generic name for any butterfly valve that has a disk totally concentric with the stem (Figure 4-15).[6] Almost all of these valves also have a single-piece resilient seat or liner that wraps over the end-flange sealing surfaces. Rubber-lined valves are almost always limited to a specific maximum pressure, which is less than the flange rating, due to the liner and disk design. Their service is also limited by temperature.

In the other type--the "high-performance," "eccentric disk," or "trunnion"--the center of the disk is offset slightly outward from the centerline of the shaft, with a spherical seating surface on the disk, and the shaft is offset slightly from the centerline of the valve body (Figure 4-15). This valve seals by a combination of shaft torque and line pressure. The high-performance type is normally rated to full American National Standards Institute (ANSI) flange rating, but still may have a maximum temperature limitation due to the seat material.

### Check Valves

Nonreturn, or check, valves take several forms, but all operate in essentially the same manner. As long as fluid is flowing through the valve, it stays open. When fluid velocity drops to zero or actually reverses, the

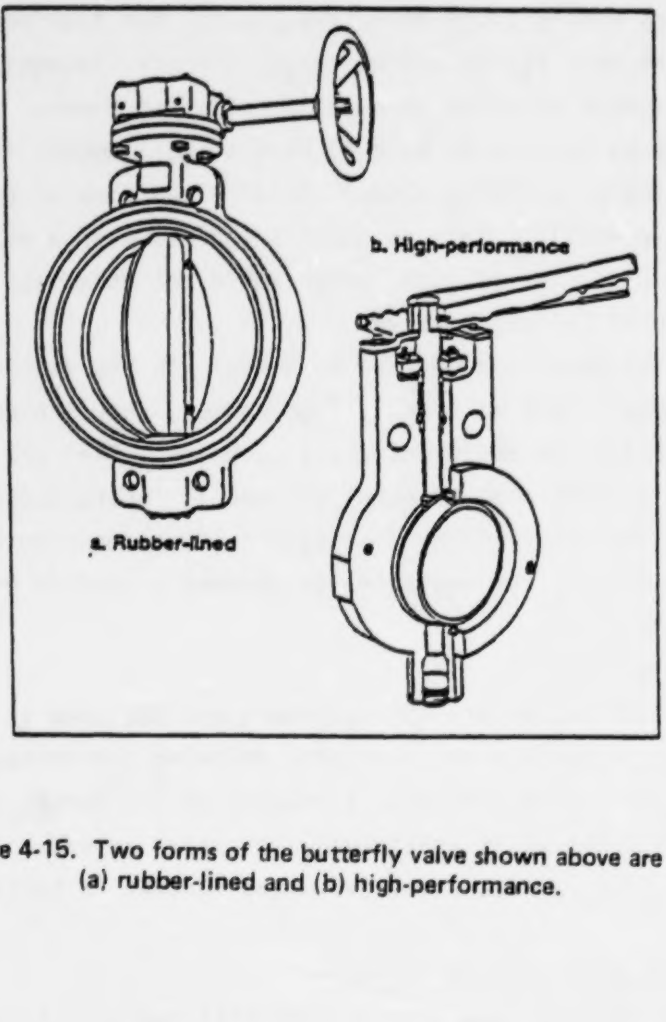


Figure 4-15. Two forms of the butterfly valve shown above are the (a) rubber-lined and (b) high-performance.

valve closes. The selection of the specific type of check valve depends on the response desired. Because an operating mechanism is usually not required, the valve is normally smaller and less expensive than other equivalent shutoff or control valves.

Some force in addition to the fluid flow is usually needed to close the valve. This force is often gravity, as in swing- and lift-check valves. In many types, a spring (often in addition to gravity) helps push the disk closed. Most spring-loaded check valves will close when, or very slightly before, the flow velocity drops to zero. Gravity-operated check valves sometimes do not really close effectively until the flow actually reverses. Depending on the mass of the moving parts, the gravity-assisted valves may open a little sooner or wider than spring-assisted types.

Some check valves can be made to pass a small amount of flow in the reverse direction by drilling a small hole in the disk or by piping a bypass around the valve itself. This is usually done to keep a small amount of circulation in a section of line, which would not otherwise be there because of the presence of the check valve.

Check valves serve a number of purposes. In the discharge piping from rotating equipment (such as a centrifugal pump), they prevent the fluid stream from turning the equipment shaft backward. They are often installed where two flow streams come together and one is intermittent or could be overpowered by the other. They also keep two streams from mixing (to prevent contamination, for instance) or prevent a section of piping from becoming overpressured.

#### Relief Valves

Safety relief valves are spring-loaded and designed to open when process pressure exceeds a set pressure, allowing the release of vapors or liquids until the system pressure is reduced to its normal operating level. When the normal pressure is reattained, the valve reseats, and a seal is again formed. This valve type is discussed further in Section 4.1.7 of this document.

### 4.1.5 Potential Leak Sources in Valves

Most valve designs have a valve stem that operates to restrict or to open the valve for fluid flow. Typically, the stem is sealed by a packing gland or O-ring to prevent leakage of organic emissions to the atmosphere, as illustrated in Figures 4-16A-G.[7] The possibility of a leak through this seal makes it a potential source of fugitive emissions. Packing glands (stuffing boxes) are the most commonly used sealing mechanism for valves, and a wide variety of packing materials are available to suit most operational requirements of temperature, pressure, and compatibility. Figure 4-17 shows the basic type of stuffing box typical for valves with a rising stem. In this type of stuffing box, an annular chamber contains the packing between the gland at the top and a shoulder at the bottom. The underside of the stuffing box carries a back seat that, combined with a corresponding seat around the stem, is utilized to isolate the packing from the fluid of the system when the valve is fully open. Packed glands can accommodate both linear and rotary motions (for rotary values). However, O-rings and most other types of gland rings can prove to be less satisfactory with linear motion and accommodate only rotary motion (see Figure 4-18).[8] Because of design and materials limitations, O-rings are much less common as the sealing mechanism for valves in chemical plants.

With time and prolonged use, the packing or sealing O-ring in the valve can fail. To eliminate the leakage of organics resulting from the seal failure, the valve packing and seals must be replaced or the valve body repaired or replaced.

### 4.1.6 Leakless Valve Technology

Some valve types and designs have little or no potential for stem leakage of organic emissions: valves with "leakless" or "sealless" technologies. These valves may be designated for no detectable emissions under the provisions of Sections 264.1057(f) and 265.1057(f) because they eliminate the conventional seals that allow leaks from around the valve stem. Control efficiencies of 100 percent have been assigned to the equipment by EPA. However, leakless valves do fail in service for a variety of reasons; when failure occurs, a significant leak can develop if the valve is not backed with conventional packing. Basically, three valve technologies can be considered leakless. These three leakless valve types are sealed-bellows valves, diaphragm valves, and pinch valves.

#### Sealed Bellows Valves

Sealed bellows valves use a bellows to seal the valve stem and totally eliminate media loss due to valve stem leakage. An example of this seal is

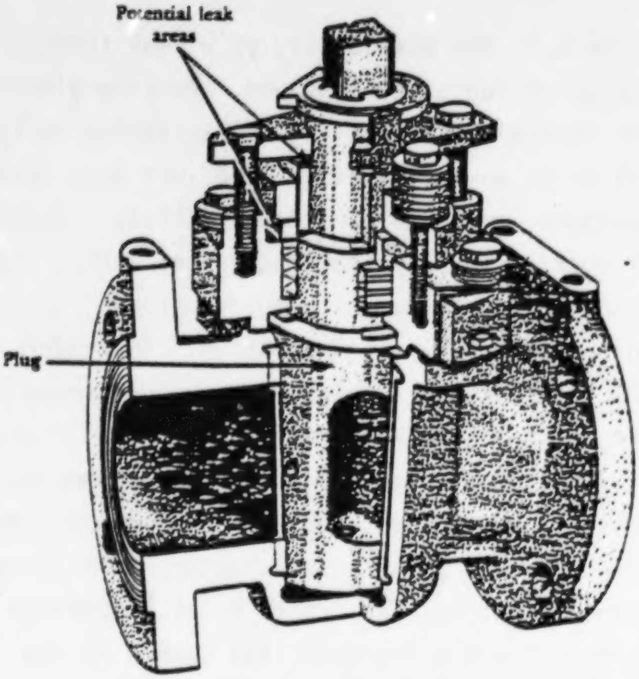


Figure 4-16A. Lubricated plug valve.

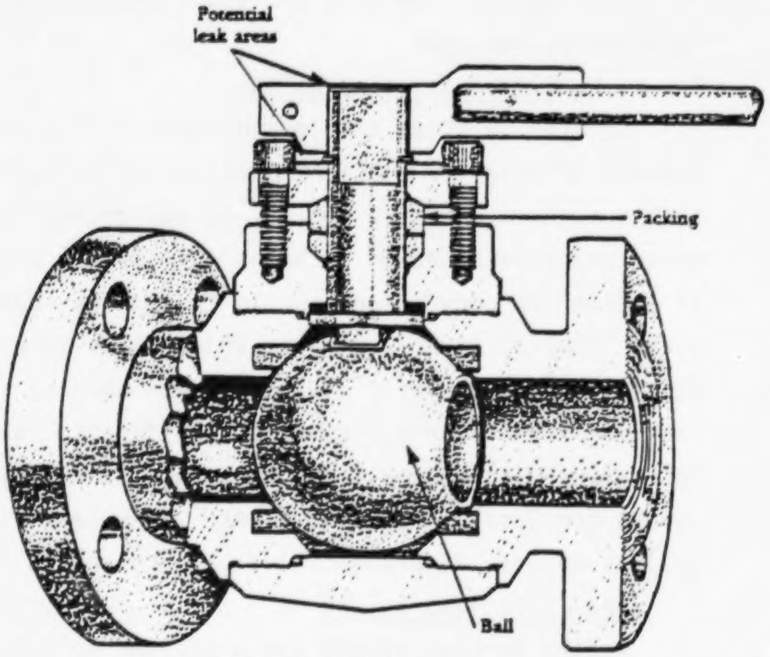


Figure 4-16B. Ball valve.

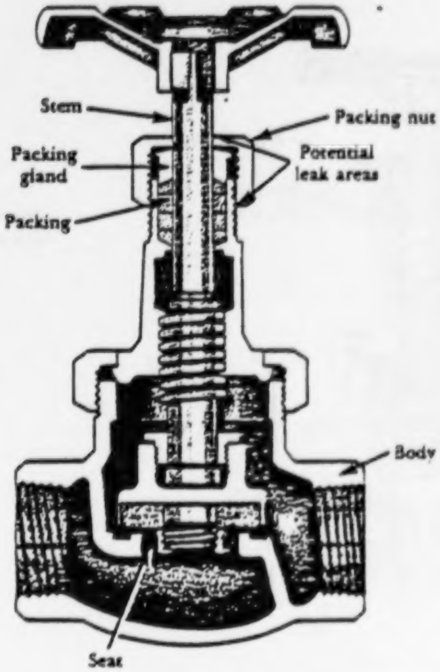


Figure 4-16C. Manual globe valve.

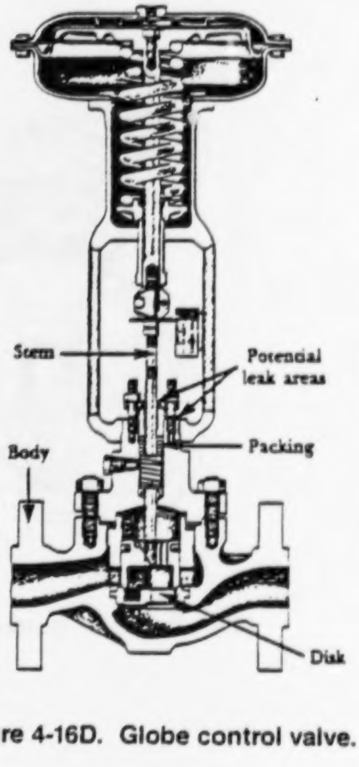


Figure 4-16D. Globe control valve.

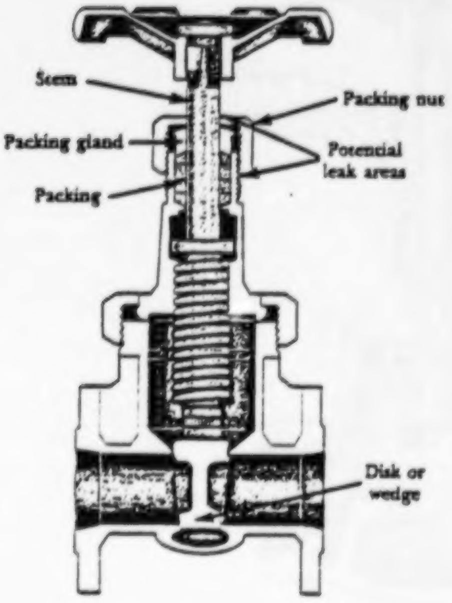


Figure 4-16E. Nonrising stem gate valve.

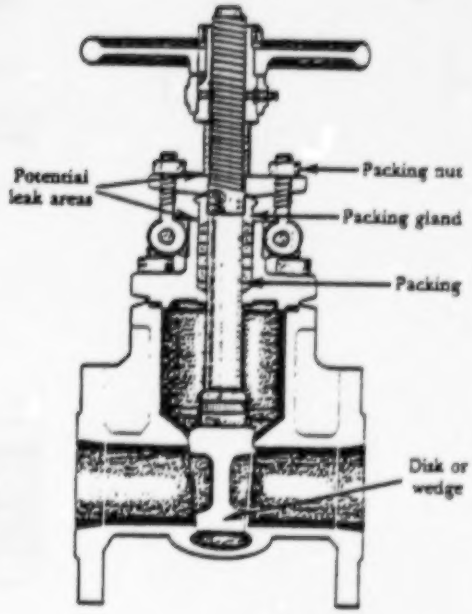


Figure 4-16F. Rising stem gate valve.

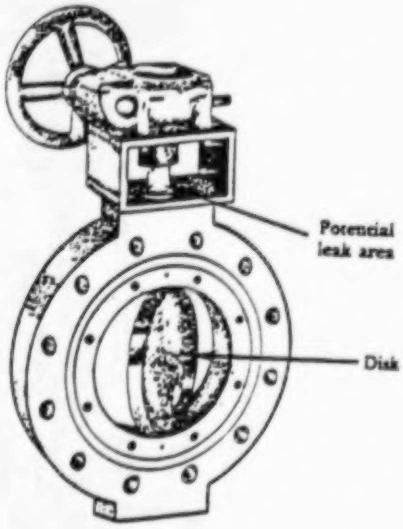


Figure 4-16G. Butterfly valve.

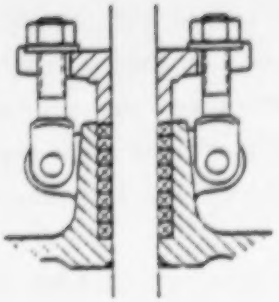


Figure 4-17. Basic stuffing box. (Courtesy of Babcock-Persta Armaturen-Vertriebsgesellschaft mbH.)

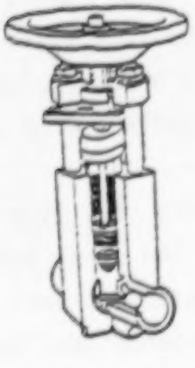


Figure 4-18. Valve stem seal with expanded graphite rings.

presented in Figure 4-19. The bellows unit is a flexible metallic membrane. The bottom end of the bellows is welded around the lower end of the stem, and the top end is welded to some part of the valve casing. A stem antirotation device is incorporated in the design to prevent torque being applied to the bellows as the valve is opened and closed.

The bellows sealing feature, in theory, can be applied to most types of valves. However, at the present time, the only valves that are widely available commercially are the globe and gate types. Sealed bellows valves in the ball-and-plug configurations are also now being produced by a single valve manufacturer.

Sealed bellows valves are used for streams in toxic chemical service (including organic streams), for high vacuum service where conventional valves tend to loose their packing, and for other very specialized service (e.g., the nuclear power industry). It is not unusual when dealing with hazardous media to fit sealed bellows valves with an additional backup gland having conventional packing or seals or with a leak detector in case of failure.

Restrictions that limit the application of sealed bellows valves include pressure and temperature limits, and stream or media characteristics. The maximum high-pressure bellows valve is rated at 1,500 lb ANSI (2,500 psig). The most frequently occurring valve pressure range is from 150 to 300 lb within which are reported to be about 80 percent of the demands of the chemical industry.

Another concern associated with this type of valve is the uncertainty of the life of the bellows seal. The metal bellows are subject to corrosion and fatigue under severe operating conditions. Corrosivity is influenced by temperature and other factors. Underestimating corrosion can lead to premature failures. Another stream characteristic that can result in problems for sealed bellows valves involves the presence of particulates (or slurries) and media with the potential to go solid. Particles (solids) can build up around the bellows and impede operation. Also, slurries and high-velocity streams can cause mechanical vibration of the bellows, which can lead to stress problems and early failure. Cost for sealed bellows valves can be as much as two to five times the price of conventional valves.

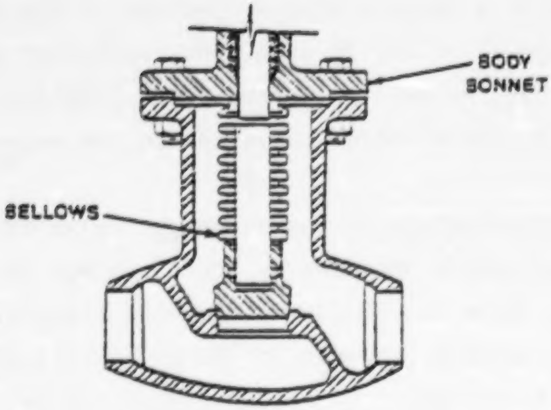


Figure 4-19. Example of bellows seals.[9]

## Diaphragm Valves

The potential for leakage around the stem of a diaphragm valve is eliminated by isolation of the valve stem from the hazardous waste stream fluid by a flexible elastomer diaphragm. The two major types of diaphragm valves are weir valves and straight-through valves. The former has a dividing weir on the valve's body below which is a mounted elastomeric diaphragm (see Figure 4-20). In the closed position, the diaphragm is seated on the weir. The design of the straight-through diaphragm valve consists of either a parallel, top-tapered, or venturi-pattern body with closure provided by a wedge-shaped projection of the diaphragm.

The diaphragm valve has an excellent reputation for handling corrosive and toxic solutions, as well as solids-laden liquids. If materials are properly selected, these valves can cater to the majority of corrosive and erosive streams.

The major disadvantage of the diaphragm valve is that temperature and pressure extremes damage and destroy the diaphragm in the valve. Depending on the material, these valves can accommodate temperatures up to 350 °F (176.6 °C) and a maximum pressure of 350 psi (weir)/225 °F (107.2 °C) and 100 psi (straight-through). Diaphragm valves are not typically backed up with conventional packing around the stem.

With regard to purchase price and maintenance cost, the diaphragm valve is competitive with the conventional valve and sells at a cost of 10 to 30 percent more than conventional valves (depending on the size and application, the diaphragm valve could be less expensive than the conventional valve).

## Pinch Valves

The concept of a double diaphragm, with two flat sheets being forced against each other to close the valve, has appeared in valves for service with corrosives and slurries. This form of the pinch valve or clamp valve, as illustrated in Figure 4-21, is similar to the diaphragm valve in design and also has an isolated stem to prevent leaks.

The basic components of the valve are a metal body, consisting of two flanged half cylinders bolted together, and two elastomer liner halves. In its simplest form, it can consist merely of a length of elastomeric tube

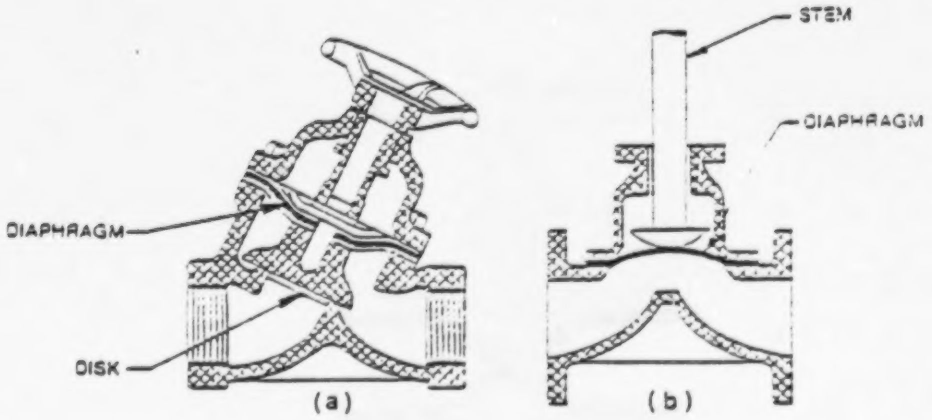


Figure 4-20. Diagrams of valves with diaphragm seals.[10]

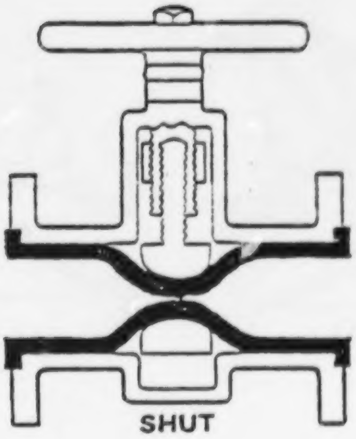


Figure 4-21. Handwheel operated pinch valve.[11]

fitted with a pinch bar mechanism. More usually, the molded rubber tube is housed in a metal body that also incorporates the pinching mechanism.

Available elastomer materials provide a wide variety of applications for the pinch valve. In general, the pinch valve is suitable for handling corrosive media, solids in suspension, and slurries because the valve can be tightly shut off and will even close when entrained solids are present in the fluid.

The problems associated with the pinch valve are flutter, low pressure rating, and compatibility of elastomer and hazardous waste stream. The pressure and temperature ratings are also limited to those of the diaphragm material.

### 4.1.7 Pressure Relief Devices

Engineering codes require that pressure-relieving devices or systems be used in applications where the process pressure may exceed the maximum allowable working pressure of the vessel. The most common type of pressure-relieving device used in chemical process units is the pressure relief valve (Figure 4-22). Typically, safety relief valves are spring-loaded and designed to open when the process pressure exceeds a set pressure, allowing the release of vapors or liquids until the system pressure is reduced to its normal operating level. When the normal pressure is reattained, the valve reseats, and a seal is again formed. The seal is a disk on a seat, and the possibility of a leak through this seal makes the pressure relief valve a potential source of organic fugitive emissions. Two potential causes of leakage from safety relief valves are "simmering or popping," a condition due to the system pressure being close to the set pressure of the valve, and improper reseating of the valve after a relieving operation.

Rupture disks are also common in chemical process units. These disks are made of a material that ruptures when a set pressure is exceeded, thus allowing the system to depressurize. A variety of types of rupture disks have been developed. The following kinds of ductile metal rupture disks are in common use (see Figure 4-23):

- Prebulged solid construction
- Prebulged, composite construction
- Flat, composite construction
- Reverse buckling.

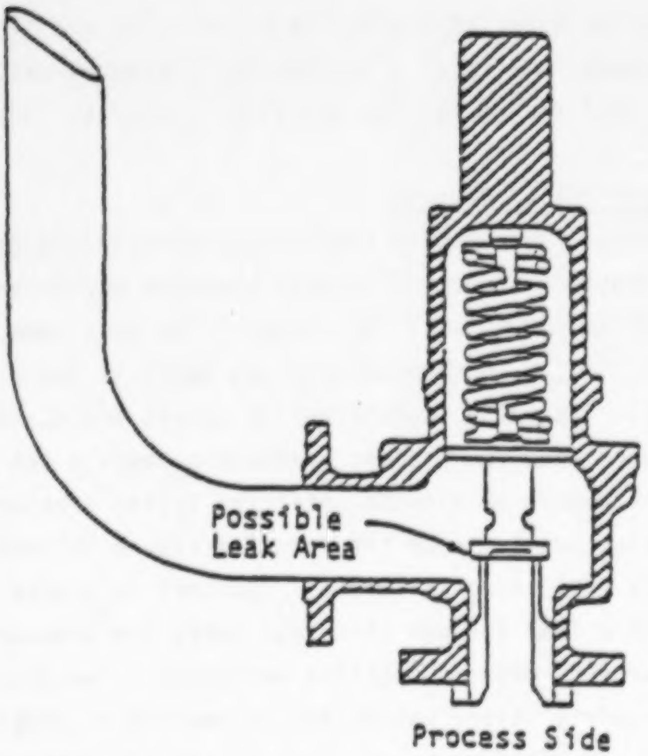
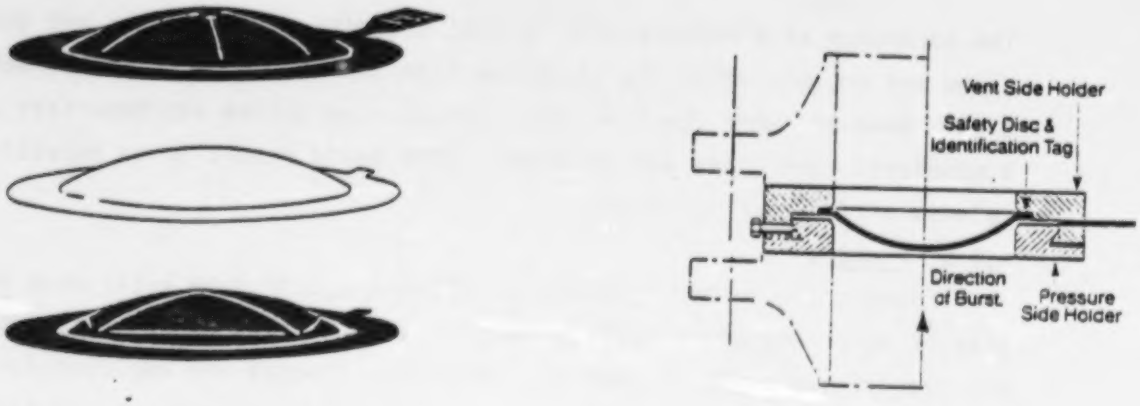
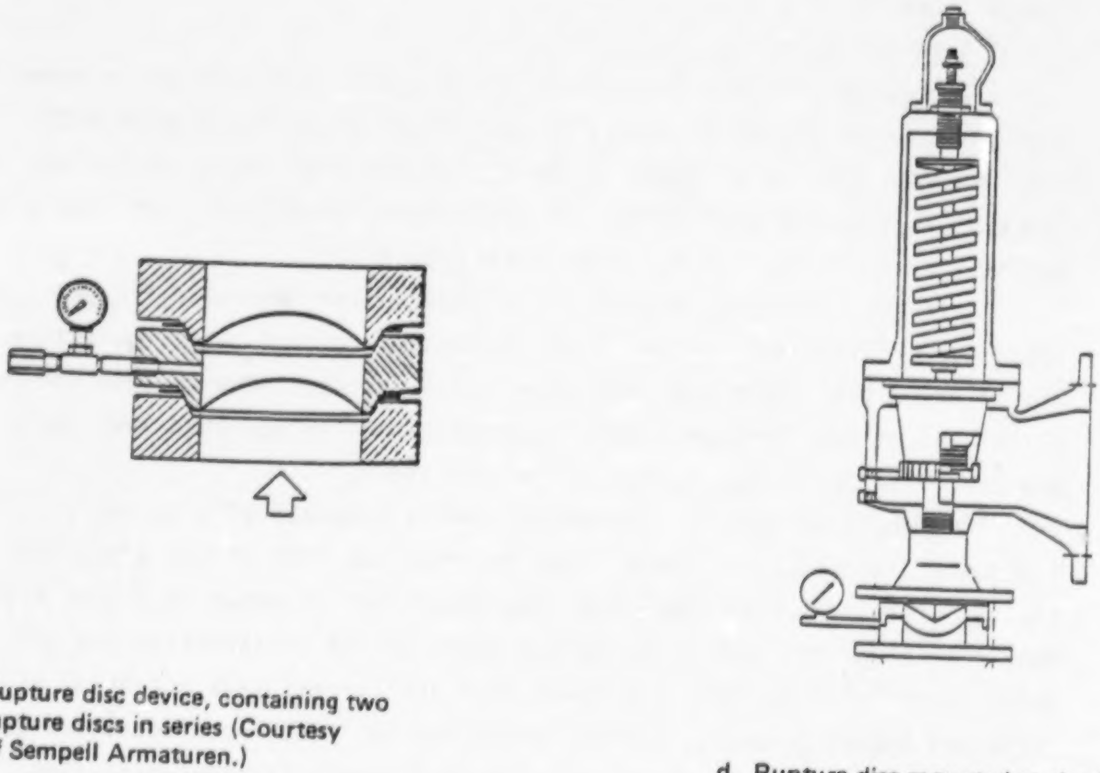


Figure 4-22. Diagram of a spring-loaded relief valve.



a. Exploded view of prebulged composite rupture disc showing slotted top section followed by seal member and vacuum support. (Courtesy of Marston Palmer Limited.)

b. Rupture disc device with reverse buckling disc of pure graphite. (courtesy of Marston Palmer Limited.)



c. Rupture disc device, containing two rupture discs in series (Courtesy of Sempell Armaturen.)

d. Rupture disc mounted to the inlet side of pressure relief valve. (Courtesy of Sempell Armaturen.)

Figure 4-23. Rupture disc.

The advantage of a rupture disk is that the disk seals tightly and does not allow any organic emissions to escape from the system under normal operation. However, when the disk does rupture, the system depressurizes until atmospheric conditions are obtained. This could result in an excessive release of fugitive emissions.

### 4.1.8 Flanges

Flanges are bolted, gasket-sealed junctions (Figure 4-24) used wherever pipe or other equipment such as vessels, pumps, valves, and heat exchangers may require isolation or removal. Normally, flanges are employed for pipe diameters for 50 mm or greater and are classified by pressure and face type.

Flanges may become fugitive emission sources when leakage occurs due to improperly chosen gaskets or a poorly assembled flange. The primary cause of flange leakage is due to thermal stress that piping or flanges in some services undergo; this results in the deformation of the seal between the flange faces.[13]

### 4.1.9 Compressors

Gas compressors used in chemical process units are similar to pumps in that they can be driven by rotary or reciprocating shafts (Figure 4-25). They are also similar to pumps in their need for shaft seals to isolate the process gas from the atmosphere. As with pumps, these seals are likely to be the source of fugitive emissions from compressors.

Shaft seals for compressors may be chosen from several different types: labyrinth, restrictive carbon rings, mechanical contact, and liquid film. All of these seal types are leak restriction devices; none of them completely eliminates leakage. Many compressors may be equipped with ports in the seal area to evacuate gases collecting there.

The labyrinth type of compressor seal is composed of a series of close tolerance, interlocking "teeth" that restrict the flow of gas along the shaft. A straight-pass labyrinth compressor seal is shown in Figure 4-26. Many variations in "tooth" design and materials of construction are available. Although labyrinth-type seals have the largest leak potential of the different types, properly applied variations in "tooth" configuration and shape can reduce leakage by up to 40 percent over a straight-pass-type labyrinth.[14]

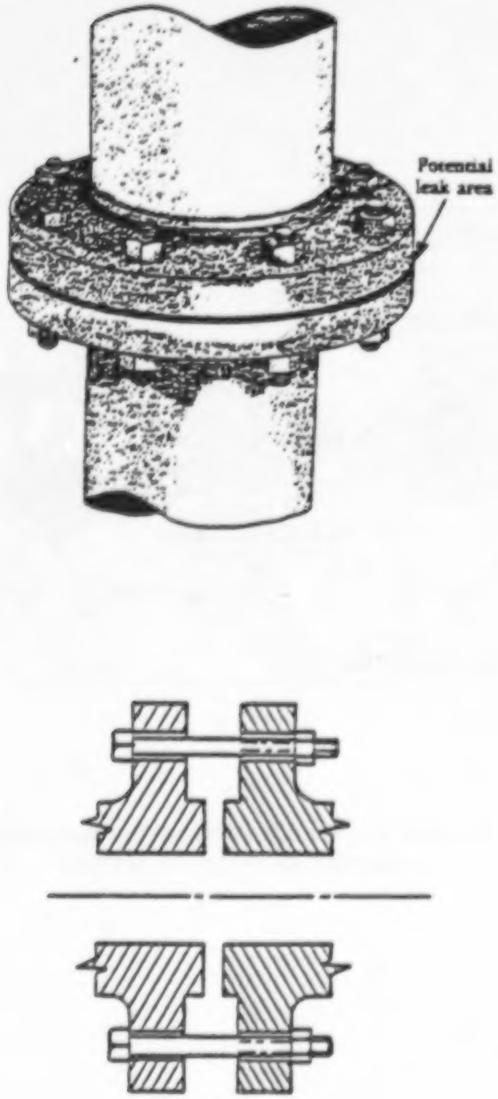


Figure 4-24. Flanged joint.[12]

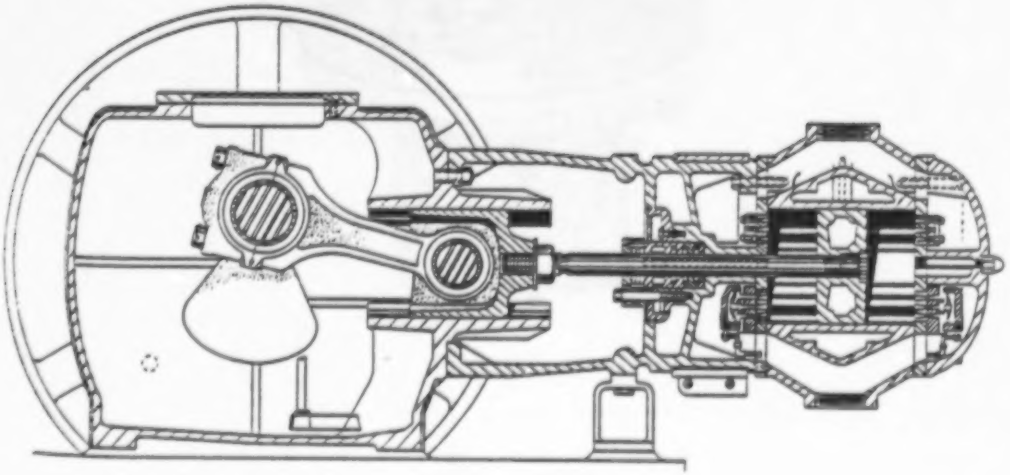


Figure 4-25. A typical single-stage water-cooled reciprocating compressor; A screw-type rotary compressor.

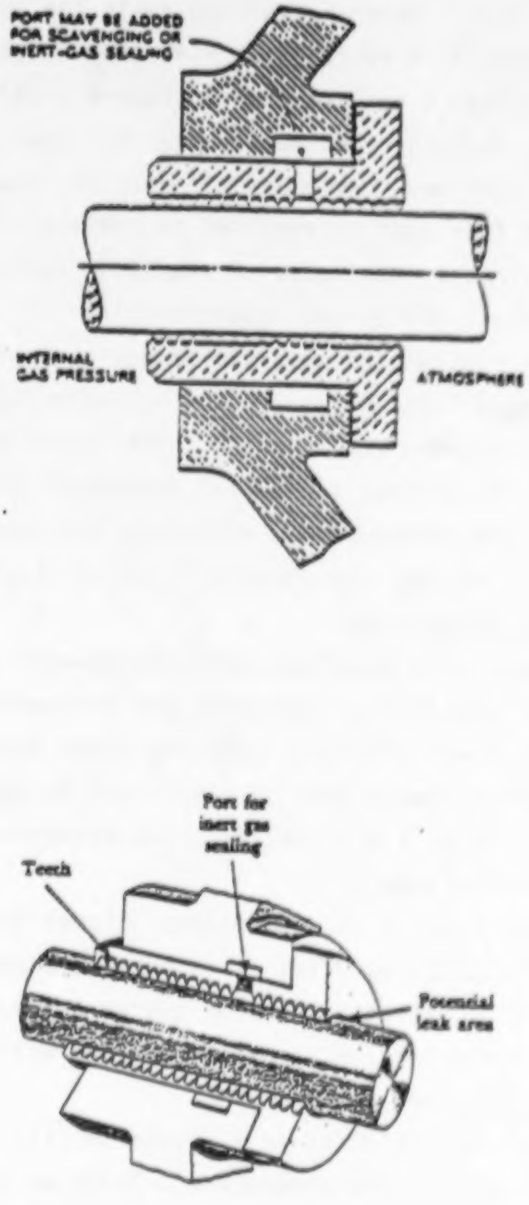

PORT MAY BE ADDED FOR SCAVENGING OR INERT-GAS SEALING
INTERNAL GAS PRESSURE
ATMOSPHERE
Port for inert gas sealing
Teeth
Potential leak area

Figure 4-26. Labyrinth shaft seal (two views).

Restrictive carbon ring seals consist of multiple stationary carbon rings with close shaft clearances. This type of seal may be operated dry or with a sealing fluid. Restrictive ring seals can achieve lower leak rates than the labyrinth.[15] A restrictive ring seal is shown in Figure 4-27.

Mechanical contact seals (shown in Figure 4-28) are similar to the mechanical seals described for pumps. In this type of seal, clearance between the rotating and stationary elements is reduced to zero. Oil or another suitable lubricant is supplied to the seal faces. Mechanical seals can achieve the lowest leak rates of the types described here, but they are not suitable for all processing conditions.[17]

Centrifugal compressors also can be equipped with liquid film seals. A diagram of a liquid film seal is shown in Figure 4-29. The seal is formed by a film of oil between the rotating shaft and stationary gland. When the circulating oil is returned to the oil reservoir, process gas can be released to the atmosphere.[18] To eliminate the release of organic emissions from the seal oil system, the reservoir can be vented to a control device.

### 4.1.10 Sampling Connections

The operation of a hazardous waste management unit is checked periodically by routine analyses of influents and effluents. To obtain representative samples for these analyses, sampling lines must first be purged prior to sampling. The purged liquid or vapor is sometimes drained onto the ground or into a sewer drain, where it can evaporate and release organic emissions to the atmosphere.

To eliminate any possible emissions, closed-purge sampling can be used. In this case, the purge material is eliminated either by collecting the purge material in a closed collection system for eventual recycle or disposal or by returning the purge material directly to the process.

### 4.1.11 Open-Ended Lines

Some valves are installed in a system so that they function with the downstream line open to the atmosphere. Examples are purge valves, drain valves, and vent valves. A faulty valve seat or incompletely closed valve would result in leakage and fugitive organic emissions to the atmosphere.

## 4.2 UNCONTROLLED FUGITIVE EMISSION ESTIMATES

The development of uncontrolled fugitive emission factors for SOCMI is described in Reference 19. The resulting emission factors are shown in

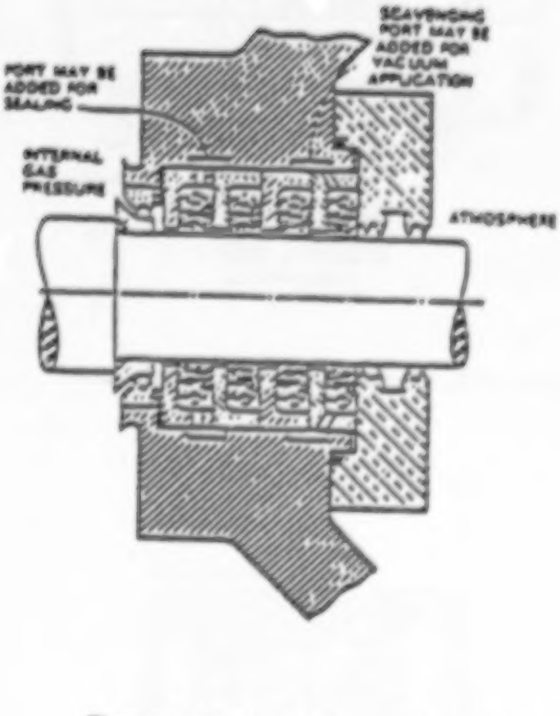

SCAVENGING PORT MAY BE ADDED FOR VACUUM APPLICATION
PORT MAY BE ADDED FOR SEALING
INTERNAL GAS PRESSURE
ATMOSPHERE

Figure 4-27. Restrictive-ring shaft seal.[16]

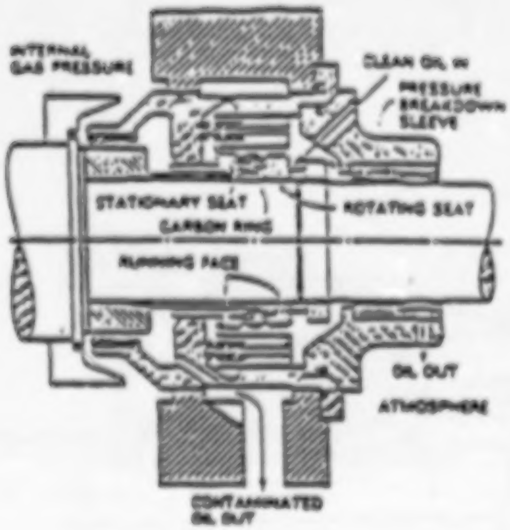


Figure 4-28. Mechanical (contact) shaft seal.

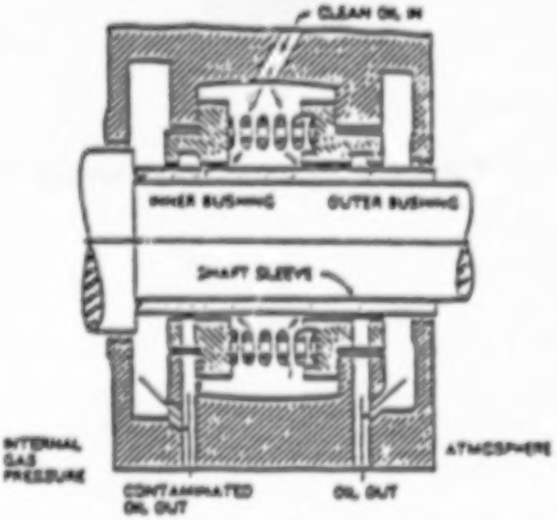


Figure 4-29. Liquid film shaft seal with cylindrical bushing.

Table 4-2. These emission factors are applicable to equipment containing or contacting hazardous wastes with organic concentrations at least 10 percent by weight at TSDF. Generally, the method for developing emission factors used leak/no leak emission factors derived from data in Reference 21 coupled with leak frequencies from Reference 22 to arrive at average emission factors for equipment in SOCMI. However, there are three exceptions: (1) The gas valve emission factor reported in Reference 23 for SOCMI units had a smaller confidence interval associated with it, and it was substituted for the emission factor derived from data in Reference 24; (2) the emission factor for sampling connections is based on the amount of sampling purge reported for every 1,000 barrels of refinery throughput[25] and the average count of sampling connections per 1,000 barrels of refinery throughput reported[26]; (3) the emission factor for open-ended lines represents valve seat leakage only. The emissions attributable to the valve, such as from around the stem and packing, are accounted for in the valve emission factor.

## 4.3 EQUIPMENT LEAK CONTROL

No single emission reduction technique can be used for all fugitive emission sources. The techniques used to control emissions from equipment leaks can be classified into two categories: equipment and work practices. An equipment control technique means that some piece of equipment is used to reduce or eliminate emissions. A common example is an add-on control device such as a vapor incinerator that is used to reduce organic emissions from a process vent. For fugitive emission sources, equipment controls include: (1) leakless technology for valves and pumps; (2) plugs, caps, blinds, etc., for open-ended lines; (3) rupture disks and soft-seats (O-rings) for pressure relief devices; (4) dual mechanical seals with barrier fluid/degassing vent systems for rotary equipment; (5) closed-loop sampling systems; and (6) enclosure of seal area/vent to a combustion control device for dynamic seals. These equipment control techniques can generally attain up to 100 percent reduction of emissions, depending on the control efficiency of the control device. Mechanical seals and those techniques that rely on a combustion control technique have been assigned an overall control efficiency of 95 percent, which is consistent with the efficiency assigned to some typically applied recovery techniques.

TABLE 4-2. EMISSION FACTORS FOR LEAKS FROM PROCESS EQUIPMENT[20]

| Equipment | Emission factors, kg/h/source |
|---|---|
| Pump seals | |
| Light liquid | 0.0494 |
| Heavy liquid | 0.0214 |
| Valves | |
| Gas | 0.0056 |
| Light liquid | 0.0071 |
| Heavy liquid | 0.00023 |
| Compressor seals | 0.228 |
| Safety relief valves--gas | 0.104 |
| Flanges | 0.00083 |
| Open-ended lines | 0.0017 |
| Sampling connections | 0.0150 |

The control techniques used for the largest number of fugitive emission sources are work practices. The primary work practice applied to pressure relief devices, valves, pumps, and other sources is leak detection and repair (LDAR) of sources. The control effectiveness of both work practices and equipment control techniques is presented in Table 4-3.

The following subsections summarize the equipment leak control requirements of Parts 264 and 265, Subpart BB. Subpart BB incorporates sections of 40 CFR 60, Subpart VV, Standards of Performance for Equipment Leaks of VOC in the Synthetic Organics Chemicals Manufacturing Industry, and of 40 CFR 61, Subpart V, National Emission Standard for Equipment Leaks (Fugitive Emission Sources).

### 4.3.1 Pumps in Light-Liquid Service (Sections 264.1052 and 265.1052)

This paragraph summarizes the equipment leak requirements for pumps in light-liquid service. Light-liquid service is determined by the methods in Sections 264.1063(h) and 265.1063(h), as described in Chapter 6.0 of this document. Each pump in light-liquid service must be in the facility LDAR program. The LDAR program requires each pump to be monitored monthly to detect leaks (Sections 264.1052[a] and 265.1052[a]) with a portable organic vapor analyzer following EPA Reference Method 21 protocol (Method 21 is described in Appendix B, and its use relative to these rules is discussed in Chapter 6.0 of this document). In addition to the monthly monitoring requirements, each pump in light-liquid service must be checked weekly by visual inspection for indications of liquid dripping from the pump seal. The following exceptions to Sections 264.1052(a) and 265.1052(a) are provided:

- The pump is equipped with a dual mechanical seal system (see Section 4.1.2 for a description of dual mechanical seals) that includes a barrier fluid system and a sensor that will detect failure of the seal system, the barrier fluid system, or both (Sections 264.1052[d] and 265.1052[d]).

- The pump is designated, as described in Sections 264.1064(g)(2) and 265.1064(g)(2), for no detectable emissions. No detectable emissions are indicated by a portable organic vapor analyzer reading of less than 500 ppm above background. The pump must also meet the requirements of Sections 264.1052(e) and 265.1052(e). Pumps that can be designated for no detectable emissions are described in Section 4.1.3.

## TABLE 4-3. EFFECTIVENESS OF CONTROLS REQUIRED BY STANDARDS[27]

| Emission source | Control technique | Control efficiency, % |
|---|---|---|
| Pump seals | | |
| Light liquid | LDAR | 61 |
| Heavy liquid | NA | 0 |
| Compressors | Mechanical seals with barrier fluid systems and control of degassing vents | 100 |
| Flanges | NA | 0 |
| Valves | | |
| Gas | LDAR | 73 |
| Liquid | LDAR | 59 |
| Safety/relief valves | | |
| Gas | Rupture disk systems | 100 |
| Liquid | Rupture disk systems | 100 |
| Sampling connections | Closed purge sampling | 100 |
| Open-ended lines | Caps, plugs, or other equipment that will close the open line | 100 |

LDAR = Leak detection and repair.
NA = Not applicable.

- The pump is equipped with a closed-vent system capable of capturing and transporting any leakage from the seal or seals to a 95-percent efficient control device as required by Sections 264.1060 and 265.1060 (Sections 264.1052[f] and 265.1052[f]).

A pump is determined to be leaking if an instrument reading of 10,000 ppm or greater is measured or there are indications of liquid dripping from the pump seal (Sections 264.1052[b] and 265.1052[b]). When a leak is detected, it must be repaired as soon as practicable, but not later than 15 calendar days after it is detected unless the delay of repair standards (Sections 264.1059 and 265.1059) apply. (Note: The term "practicable" refers to a balance between eliminating a source of organic emissions and allowing the operator sufficient time to obtain necessary repair parts and maintain some degree of flexibility in overall plant maintenance scheduling.) The first attempt at repair must be made within 5 calendar days of the leak being detected (Sections 264.1052[c] and 265.1052[c]). First attempts at repair include, but are not limited to, the following: tightening of packing gland nuts and injection of lubricant into lubricated packing.

Delay of repair for equipment for which leaks have been detected is allowed if a hazardous waste management unit shutdown is required. In such a case, repair of this equipment must be made before the end of the next hazardous waste management unit shutdown (Sections 264.1059[a] and 265.1059[a]). Delay of repair also is allowed for equipment that is isolated from the hazardous waste management unit and that does not continue to contain or contact hazardous waste with organic concentrations of at least 10 percent by weight (Sections 264.1059[b] and 265.1059[b]). Provisions specific to pumps allow delay of repair if repair requires the use of a dual mechanical seal system that includes a barrier fluid system and repair is completed as soon as practicable, but not later than 6 months after the leak was detected (Sections 264.1059[c] and 265.1059[c]).

### 4.3.2 Valves in Gas/Vapor Service or in Light-Liquid Service (Sections 264.1057 and 265.1057)

This paragraph summarizes the equipment leak requirements for valves in gas/vapor service or in light-liquid service. A valve is in gas/vapor service if it contains or contacts a hazardous waste stream that is in the gaseous state at operating conditions (Section 264.1031). Light-liquid service is determined by the methods in Sections 264.1063(h) and 265.1063(h), as described in Chapter 6.0 of this document. Each valve in gas/vapor service or light-liquid service must be in the facility LDAR program. The LDAR program requires that valves be monitored monthly for leaks with a portable organic vapor analyzer following EPA Reference Method 21 protocol (Method 21 is described in Appendix B, and its use relative to these rules is discussed in Chapter 6.0 of this document).

Any valve for which a leak is not detected for 2 successive months may be monitored the first month of each succeeding quarter, beginning with the next quarter, until a leak is detected (Sections 264.1057[c][1] and 265.1057[c][1]). Once a leak has been detected, the valve must be monitored monthly until a leak is not detected for 2 successive months (Sections 264.1057[c][2] and 265.1057[c][2]) with the following exceptions:

- The valve is designated, as described in Sections 264.1064(g)(2) and 265.1064(g)(2), for no detectable emissions. No detectable emissions are indicated by a portable organic vapor analyzer reading of less than 500 ppm above background. The valve must also meet the requirements of Sections 264.1057(f) and 265.1057(f). Valves that can be designated for no detectable emissions are described in Section 4.1.6 of this chapter.

- The valve is designated, as described in Sections 264.1064(h)(1) and 265.1064(h)(1), as an unsafe-to-monitor valve. A valve may be classified as unsafe to monitor because of process conditions such as extreme temperatures or pressures. The owner or operator must determine that the valve is unsafe to monitor because monitoring personnel would be exposed to an immediate danger, and must adhere to a written plan that requires monitoring of the valve as frequently as practicable during safe-to-monitor times (Sections 264.1057[g] and 265.1057[g]). For example, some valves might be monitored at times when process conditions are such that the valve is not operating under extreme temperature and pressure as would be found in high-pressure polymer reactors.

- The valve is designated, as described in Sections 264.1064(h)(2) and 265.1064(h)(2), as a difficult-to-monitor valve. Some valves are difficult to monitor because access to the valve bonnet is restricted or the valve is located in an elevated area. The owner or operator must determine that the valve cannot be monitored without elevating the monitoring personnel more than 2 meters above a support surface, and a written plan must be followed that requires monitoring of the valve at least once per calender year (Sections 264.1057[h] and 265.1057[h]).

- The owner or operator elects to comply with an allowable percentage of valves leaking of equal to or less than 2.0 percent by meeting the requirements of Sections 264.1061 and 265.1061.
- The owner or operator elects to comply with skip period LDAR work practices by meeting the requirements of Sections 264.1062 and 265.1062.

Table 4-4 illustrates how a "skip-period" monitoring program (Sections 264.1062 and 265.1062) might be implemented in practice. In this case, the "good performance level (2 percent or less of valves leaking)" must be met for five consecutive quarters (i=5) before three quarters of leak detection could be skipped (m=3). If the quarterly LDAR program showed that 2 percent or less of the valves in gas service and valves in light-liquid service or gas/vapor service in a process unit were leaking for each of five consecutive quarters, then three quarters could be skipped following the fifth quarter in which the percent of these valves leaking was less than the "good performance level." After an additional three quarters were skipped, all valves would be monitored again in the fourth quarter. This strategy would permit the owner/operator of a process unit that has consistently demonstrated it is meeting the "good performance level" to monitor valves in gas service and valves in light-liquid service annually instead of quarterly.

Because the provisions of the above alternative standards for the valves in gas/vapor service or light-liquid service are similar, it is important to note their differences. The "skip period leak detection standard" can only be applied if the requirements of 264.1057 and 265.1057 have been met and no leak has been detected for two consecutive quarters. However, the "percentage of valves allowed to leak standard" does not require the valve standards of Sections 264.1057 and 265.1057 to be met before it is applicable. Another difference is the frequency of monitoring. For example, with the "skip period leak detection standard," if a period of two consecutive quarters had a percentage of 2 percent or less leaking valves, the owner or operator may begin to skip one of the quarterly leak detection periods. Accordingly, three quarterly periods can be skipped after five consecutive quarters with 2 percent or less leaking valves. In contrast, with the "percentage of valves allowed to leak standard," the valves are monitored once initially, annually, and at times requested by the Regional Administrator.

TABLE 4-4. ILLUSTRATION OF A SKIP-PERIOD MONITORING PROGRAM[a]

| Leak detection period | Leak rate of valves during period, % | Quarterly action taken (monitor vs skip) | Good performance level achieved? |
|---|---|---|---|
| 1 | 3.1 | Monitor | No |
| 2 | 0.8 | Monitor | Yes 1 |
| 3 | 1.4 | Monitor | Yes 2 |
| 4 | 1.3 | Monitor | Yes 3 |
| 5 | 1.9 | Monitor | Yes 4 |
| 6 | 0.6 | Monitor | Yes 5[b] |
| 7 | -- | Skip | - 1 |
| 8 | -- | Skip | - 2 |
| 9 | -- | Skip | - 3 |
| 10 | 3.8 | Monitor | No 4[c] |
| 11 | 1.7 | Monitor | Yes 1 |
| 12 | 1.5 | Monitor | Yes 2 |
| 13 | 0.4 | Monitor | Yes 3 |
| 14 | 1.0 | Monitor | Yes 4 |
| 15 | 0.9 | Monitor | Yes 5[b] |
| 16 | -- | Skip | - 1 |
| 17 | -- | Skip | - 2 |
| 18 | -- | Skip | - 3 |
| 19 | 0.9 | Monitor | Yes 4[d] |
| 20 | -- | Skip | - 1 |
| 21 | -- | Skip | - 2 |
| 22 | -- | Skip | - 3 |
| 23 | 1.9 | Monitor | Yes 4[d] |

[a] i=5, m=3, good performance level of 2 percent.

[b] Fifth consecutive quarter below 2 percent means three quarters of monitoring may be skipped.

[c] Percentage of leaks above 2 percent means quarterly monitoring reinstituted.

[d] Percentage of leaks below 2 percent means three quarters of monitoring may be skipped.

As far as monitoring is concerned, a valve is determined to be leaking if an instrument reading of 10,000 ppm or greater is measured (Sections 264.1057[b] and 265.1057[b]). When a leak is detected, it must be repaired as soon as practicable, but not later than 15 calendar days after the leak is detected unless delay of repair is allowed under the provisions of Sections 264.1059 and 265.1059. The first attempt at repair must be made within 5 calendar days of the leak being detected (Sections 264.1057[d][2] and 265.1057[d][2]).

The general delay-of-repair provisions for equipment for which leaks have been detected are described in Section 4.3.1 of this chapter. Delay of repair for valves is allowed if emissions of purged material resulting from immediate repair are greater than the emissions likely to result from delay of repair and when repair procedures are effected, the purged material is collected and destroyed in a 95-percent efficient control device (Sections 264.1059[c] and 265.1059[c]). Also, delay of repair beyond a hazardous waste management unit shutdown is allowed for a valve if valve assembly replacement is necessary during the hazardous waste management unit shutdown and valve assembly supplies have been depleted from a once-sufficient inventory. Delay of repair beyond the next hazardous waste management unit shutdown will not be allowed unless the next hazardous waste management unit shutdown occurs sooner than 6 months after the first hazardous waste management unit shutdown (Sections 264.1059[e] and 265.1059[e]).

### 4.3.3 Pumps and Valves in Heavy-Liquid Service, Pressure Relief Devices in Light-Liquid or Heavy-Liquid Service, and Flanges and Other Connectors (Sections 264.1058 and 265.1058)

A piece of equipment is in heavy-liquid service if it is not in gas/vapor service or in light-liquid service (Section 264.1031). Each pump and valve in heavy-liquid service, pressure relief device in light-liquid or heavy-liquid service, and flange and other connector must be monitored within 5 days with a portable organic vapor analyzer following EPA Reference Method 21 protocol if evidence of a potential leak is found by visual, audible, olfactory, or any other detection method. A leak is detected if an instrument reading of 10,000 ppm or greater is measured. When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected unless the delay of repair standards described in Sections 4.3.1 and 4.3.2 of this chapter apply. The first attempt at repair must be made within 5 calendar days of the leak being detected.

### 4.3.4 Compressors (Sections 264.1053 and 265.1053)

This paragraph summarizes the equipment leak control requirements for compressors. Each compressor must be equipped with a seal system that includes a barrier fluid system with a sensor to indicate failure of the seal system, the barrier fluid system, or both such that leakage of process fluid to the atmosphere is prevented (Sections 264.1053[a]-[e] and 265.1053[a]-[e]) with the following exceptions:

- The compressor is equipped with a closed-vent system capable of capturing and transporting any leakage from the seal to a 95-percent efficient control device as required by Sections 264.1060 and 265.1060.

- The compressor is designated, as described in Sections 264.1064(g)(2) and 265.1064(g)(2), for no detectable emissions. No detectable emissions are indicated by a portable organic vapor analyzer reading of less than 500 ppm above background. The compressor must be tested for no detectable emissions upon designation, annually, or at other times requested by RCRA permit writers/reviewers (Sections 264.1053[i] and 265.1053[i]).

A compressor is determined to be leaking if the sensor indicates failure of the seal system, the barrier fluid system, or both. When a leak is detected, it must be repaired as soon as practicable, but not later than 15 calendar days after it is detected unless the delay of repair standards described in Section 4.3.1 for equipment in general apply. The first attempt at repair must be within 5 calendar days of the leak being detected.

### 4.3.5 Pressure Relief Devices in Gas/Vapor Service (Sections 264.1054 and 265.1054)

This paragraph summarizes the equipment leak control requirements for pressure relief devices in gas/vapor service. A pressure relief device is in gas/vapor service if it contains or contacts a hazardous waste stream that is in the gaseous state at operating conditions (Section 264.1031). Except during pressure releases, each pressure relief device in gas/vapor service must be operated with no detectable emissions unless the pressure relief device is equipped with a closed-vent system capable of capturing and transporting leakage from the pressure relief device to a 95-percent efficient control device as required by Sections 264.1060 and 265.1060. No detectable emissions are indicated by a portable organic vapor analyzer reading of less than 500 ppm above background. After each pressure release, the pressure relief device must be returned to a condition of no detectable emissions as soon as practicable, but no later than 5 calendar days after the pressure release unless the delay of repair standards (described in Section 4.3.1 of this chapter) apply. No later than 5 calendar days after the pressure release, the pressure relief device must be monitored by portable organic vapor analyzer to confirm the condition of no detectable emissions.

### 4.3.6 Sampling Connection Systems (Sections 264.1055 and 265.1055)

This paragraph describes the equipment leak control requirements for sampling connection systems. Each sampling connection system must be equipped with a closed-purge system or closed-vent system except where an alternative means of emission limitation other than a thermal incinerator, catalytic incinerator, flare, boiler, process heater, condenser, or carbon adsorption system is used to comply with the requirements of the regulation. In-situ sampling systems are also exempt from the control requirements of this section. Each closed-purge or closed-vent system must meet the requirements of Sections 264.1060 or 265.1060.

### 4.3.7 Open-Ended Valves or Lines (Sections 264.1056 and 265.1056)

This paragraph describes the equipment leak control requirements for open-ended valves or lines. Each open-ended valve or line must be equipped with a cap, blind flange, plug, or a second valve except where an alternative means of emission limitation other than a thermal incinerator, catalytic incinerator, flare, boiler, process heater, condenser, or carbon adsorption system is used to comply with the requirements of the regulation. The cap, blind flange, plug, or second valve must seal the open end at all times except during operations requiring process fluid flow through the open-ended valve or line. An open-ended valve or line equipped with a second valve must be operated in a manner such that the valve on the hazardous waste stream end is closed before the second valve is closed. If a double block-and-bleed system is used, the bleed valve or line may remain open during operations that require venting the line between the block valves but must be equipped with a cap, blind flange, plug, or a second valve at all other times.

## 4.4 REPAIR METHODS

The following descriptions of repair methods include only those features of each fugitive emission source (pump, valve, etc.) that need to be considered in assessing the applicability and effectiveness of each method. They are not intended to be complete repair procedures.

### 4.4.1 Pumps

Many process units have spare pumps that can be operated while the leaking pump is being repaired. Leaks from packed seals may be reduced by tightening the packing gland. At some point, however, the packing may deteriorate to the point where further tightening would have no effect or possibly even increase fugitive emissions from the seal. The packing can be replaced with the pump out of service. Appendix B gives a brief illustration of how to pack a pump. When mechanical seals are used, the pump must be dismantled so the leaking seal can be repaired or replaced. Dismantling pumps may result in spillage of some process fluid causing organic emissions. These temporary emissions could be greater than the continued leak from the seal. Therefore, the pump should be drained of as much of the organics as possible before opening for seal replacement.

### 4.4.2 Valves

Most valves have a packing gland that can be tightened while in service. Although this procedure should decrease the emissions from the valve, in some cases it may actually increase the emission rate if the packing is old and brittle or has been overtightened. Plug-type valves can be lubricated with grease to reduce emissions around the plug. Some types of valves have no means of in-service repair and must be isolated from the process and removed for repair or replacement. Other valves, such as control valves, may be excluded from in-service repair by operating procedures or safety procedures (the valve should be drained of organics that are to be properly disposed of before opening the value for repair). In some instances, isolating a valve may be relatively easy; for example, if a manual bypass loop is available, or if the process operation can be changed temporarily. But in most cases, the isolation of a valve can be achieved only by a process shutdown--a major operation. If a hazardous waste management unit must be shut down to isolate a leaking valve, the emissions resulting from the shutdown might be greater than the emissions from the valve if it were allowed to leak until the next scheduled unit shutdown permits isolation for repair.

Depending on site-specific factors, it may be possible to repair process valves by injection of a sealing fluid into the source. Injection of sealing fluid has been successfully used to repair leaks from valves in petroleum refineries in California.[28] In some cases, valves are replaced rather than repaired. Extremely small valves can be difficult to repack and may therefore be replaced after failure. If a hazardous waste management process requires a high degree of purity (such as the recycling of pharmaceutical chemicals), it may also be necessary to replace a valve rather than repair it.

### 4.4.3 Compressors

Leaks from packed seals may be reduced by the same repair procedure that was described for pumps. Other types of seals require that the compressor be out of service for repair. Because most compressors normally do not have spares, repair or replacement of the seal would require a shutdown of the process. If the leak is small, temporary emissions resulting from a shutdown could be greater than the emissions from the leaking seal. Therefore, a compressor should be flushed of as much of the organics as possible before opening for seal replacement.

### 4.4.4 Safety/Relief Valves

Emissions of organics from safety/relief valves, in general, result from leakage of the organics around the valve seat. The leakage is most commonly attributable to improper seating of the valve, initially or after overpressure relieving. There are basically three means of eliminating leaks from safety/relief valves: (1) installation of a rupture disk in the line prior to the relief valve; (2) connection of the discharge port of the relief valve to a closed-vent system; and (3) use of soft seat technology such as elastomer "O-rings."

Used upstream of the safety/relief valve, a rupture disk effectively seals the process below the set pressure of the disk. When this set pressure is exceeded, the rupture disk will break, allowing the safety/relief valve to relieve the process overpressure. The American Society of Mechanical Engineers (ASME) codes provide for such installations and set forth the design constraints for installing rupture disks in conjunction with relief valves.[29] ASME codes also provide design criteria to prevent potential safety hazards from pressure building between the disk and valve. For example, a pressure gauge and bleed valve installed between the disk and relief valve provide an indication of leakage around the disk and the means to relieve this pressure.

After an overpressure relief, a new rupture disk would have to be installed to reseal the system. For such an arrangement, it may be necessary to install a three-way valve with a parallel relief valve. This would allow isolation of the rupture disk/relief valve system for disk replacement, while maintaining a backup relief valve in service. A block valve upstream of the rupture disk/relief valve system will accomplish the same purpose where safety codes allow the use of a block valve in relief valve service.

The second method that effectively eliminates leaks from safety/relief valves is connection of the relief valve discharge port to a closed-vent system. A closed-vent system is composed of piping, connections, and, where necessary, flow-inducing devices (e.g., fans, compressors); the system transports gas or vapor to a control device such as a flare, incinerator, boiler, or process heater. In connecting a safety/relief valve to a closed-vent system, any leakage through the seat of the valve will be destroyed in the control device.

### 4.4.5 Flanges

Occasionally, flange leaks can be sealed effectively by simply tightening the flange bolts. If a flange leak requires off-line gasket seal replacement, a total or partial shutdown will probably be necessary because most flanges cannot be isolated. Temporary flange repair methods can be used in many cases. The emissions resulting from shutting down a unit would probably be larger than the continuous emissions that would result from not shutting down the unit until the time for a shutdown for other reasons (unless a leak is major). Flange leak incidences are very low and many can be corrected by on-line maintenance. Data from petroleum refineries show that flanges emit very small amounts of organics.[30]

## 4.5 PERCENT EFFECTIVENESS OF CONTROL BY LDAR TECHNIQUES

For some sources of equipment leak fugitive emissions, LDAR programs provide an effective means of reducing the total organics emitted. The emissions reduction potential for LDAR as a control technique is highly variable depending on several factors. The principal element impacting emissions reduction is the frequency of monitoring (surveying) sources for leak detection. For example, a monthly monitoring plan would typically be more effective in reducing emissions than a quarterly monitoring plan because leaks would be found and corrected more quickly. Some characteristics of individual sources also affect emission reduction: leaking emission factor (as compared to the nonleaking emission factor), leak occurrence rate, leak recurrence rate, and repair effectiveness.

Using specific source characteristics, an evaluation of control effectiveness can be made for different monitoring plans using the EPA's LDAR Model. The model is detailed in a technical note,[31] and the development of the model is summarized in Reference 32. The model is a set of recursive equations that operates on an overall population of sources that can be segregated into the following subgroups for any given monitoring interval: (1) sources that leak due to the leak occurrence rate; (2) sources that leak and cannot be repaired below the 10,000 ppmv leak definition; (3) sources that leaked, were repaired successfully, but leaked again soon after the repair (i.e., leak recurrence); and (4) sources that do not leak (i.e., those screening below the 10,000 ppmv leak definition). The relative numbers of sources in each subgroup change with each monitoring interval step, based on the characteristics for the sources.

The input parameters used in examining an LDAR program for valves and pumps based on monthly monitoring are shown in Table 4-5. The LDAR Model used to estimate emission reductions gives incremental results as well as results for a program that has been established. For the example, once a monthly monitoring plan is in place, emission reductions of 73 percent and

TABLE 4-5. INPUT PARAMETERS FOR LDAR MODEL[a]

| Input parameter | Values selected<br>Pumps, light liquid | <br>Valves, gas | <br>Valves, light liquid |
|---|---|---|---|
| Emission factor, kg/hr/source | 0.0494 | 0.0056 | 0.007 |
| Occurrence rate, percent | 3.4 | 3.8 | 3.8 |
| Initial leak frequency, percent | 8.8 | 11.4 | 6.5 |
| Fractional emission reduction from: | | | |
| (a) unsuccessful repair | 0 | 0.626 | 0.626 |
| (b) successful repair | 0.972 | 0.977 | 0.977 |
| Fraction of sources for which repair attempts failed | 0 | 0.1 | 0.1 |
| Fraction of repaired sources exhibiting early leak recurrence | 0 | 0.14 | 0.14 |
| Turnaround frequency, yr | 2 | 2 | 2 |

[a] Selection of input parameters discussed in Reference 33.

59 percent can be expected for valves in gas and light-liquid services; likewise, a 61-percent reduction in emissions can be achieved for pumps in light-liquid service under a monthly LDAR plan.

Table 4-6 presents the estimated control effectiveness obtained using the LDAR model for simple monthly, quarterly, semiannual, and annual monitoring of valves and pumps. Additionally, the monthly/quarterly hybrid program allowed by EPA for valves is shown. These results show that, as monitoring frequency is increased, the anticipated emission reduction increases. Further, the results indicate some instances where there is no positive effect in reducing emissions due to monitoring and repair on too infrequent a schedule. Such results, however, are subject to interpretation for specific cases because they are based on "average" input values for an entire industry.

TABLE 4-6. ESTIMATED CONTROL EFFECTIVENESS FOR LDAR PROGRAMS FOR VALVES AND PUMPS (decimal percent)

| | Valves | | |
|---|---|---|---|
| Monitoring interval | Gas | Light-liquid | Pumps |
| Monthly | 0.73 | 0.59 | 0.608 |
| Monthly/quarterly | 0.65 | 0.46 | -- |
| Quarterly | 0.64 | 0.44 | 0.325 |
| Semiannual | 0.50 | 0.22 | (0.076)[a] |
| Annual | 0.24 | (0.19) | (0.800)[a] |

[a] Values in parentheses indicate negative efficiencies.

## 4.6 ADDITIONAL CONTROLS FOR EQUIPMENT LEAKS

The omnibus permitting authority of Section 270.32 allows permit writers to require, on a case-by-case basis, emission controls that are more stringent than those specified by a standard. This authority could be used in situations where, in the permit writer's judgment, there is an unacceptably high risk after application of controls required by an emission standard.

The EPA intends to prepare guidance to be used by permit writers to help identify facilities that would potentially have high residual risk due to air emissions. Once the permit writer has determined that a particular facility may have a high risk after controls required by emission standards are in place, it may be necessary to require additional controls beyond those levels required by the standards. This section provides a general discussion of the controls available for equipment leaks (i.e., pumps, valves, compressors, flanges, sampling connections, and so on) that would result in control levels more stringent than the level achieved under the requirements of Subpart BB of Parts 264 and 265.

### 4.6.1 Pumps

The equipment leak rules require monthly leak detection monitoring for pumps in light-liquid service (see Section 4.3.1). As noted in Table 4-4, with the implementation of the monthly LDAR for pumps, an overall emission control efficiency of about 61 percent can be expected. However, the level of control required by the LDAR program does not result in the highest level of emission control that could be achieved for fugitive emissions from pumps. For example, in appropriate circumstances, pumps can be controlled by dual mechanical seals that would capture nearly all fugitive emissions. An overall control efficiency of 95 percent could be achieved with dual mechanical seals based on venting of the degassing reservoir to a control device that meets the requirements of Subpart BB. Costs for dual mechanical seal systems can range from $4,500 to nearly $10,000 per pump for installing a packaged and pressurized recirculating system without a cooler, for pumps in the 60 to 400 gal/min range (see Tables 4-7 and 4-8 for additional information on the cost of dual mechanical seals).

Leakless pumps (see Section 4.1.3) such as the canned-motor pump, diaphragm pumps, and other sealless pumps can be used in specific situations. Sealless pumps are designed to eliminate the use of seals and therefore do not leak. These sealless pumps do have limited applicability and care must be exercised in prescribing their use.

### 4.6.2 Valves

Based on results of the EPA's LDAR model, once a monthly leak detection monitoring plan is in place, emission reductions of 73 percent and 59

TABLE 4-7. DUAL MECHANICAL SEAL SYSTEM COST PER PUMP

| Item | 1986 Dollars | Cost basis |
|---|---|---|
| Double mechanical seals (new) | | |
| Seal cost | 1,700 | |
| Installation | 475[a] | 19 h at $25/h |
| Savings on single seal | (400) | Credit allowed for the cost of a single seal that would have been installed in place of the DMS |
| Installed capital cost | 1,775 | |
| Double mechanical seal (retrofit) | | |
| Seal cost | 1,700 | |
| Installation | 1,000 - 10,000 | Installation of DMS on existing pumps requires approximately 20 man-hours per pump |
| Seal credit[b] | (200) | Return (salvage) value of the old seal |
| Savings on single seal[b] | (400) | Credit allowed for the cost of the single seal that would have been installed in place of the double mechanical seal |
| Labor savings | (100) | 4 h at $25/h |
| Installed capital cost | (2,000)[c] | Assumes a retrofit installation labor of $1,000 |
| Barrier fluid systems for DMS | 2,625 | Reservoir system (i.e., tank, pump, and cooler) |
| Closed-vent system DMS | 5,250 | Piping, plug valves, and flame arrestors ($10,500 per 2 pumps) |
| Total new DMS system cost | 9,650 | Does not include the cost of a control device[d] |
| Total retrofit DMS system cost | 9,875[e] | Does not include the cost of a control device[d] |

TABLE 4-7 (continued)

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[a] Total installation cost per pump for new and existing pumps in 1988 dollars.

[b] Savings depends on replacement time. If the seal is replaced upon failure, then credit is allowed. If a single seal has useful life when replaced, no credit should be allowed.

[c] A chemical plant installed dual mechanical seal (DMS) and barrier fluid systems on 15 pumps. The cost of materials (including seals, fittings, piping, reservoir, and level detector) was ~$68,000 for 15 pumps. The cost of labor to make the necessary modifications and to install the controls was $156,000 and included installation of seals on pumps as well as piping for nonrecirculating barrier fluid. The total installed cost of $224,000 yields an estimate of $14,900 per pump. The system includes a pressurized reservoir with a level detector and alarm. The barrier fluid is not recirculated and degassing reservoir vents are not used.

[d] It is anticipated that the majority of TSDF can operate the DMS barrier fluid system at a pressure that is at all times greater than the pump stuffing box pressure. In such cases, the TSDF are not required to degas the fluid and vent the vapor to a control device. With a barrier fluid higher than the pump pressure, any leak from a pump seal failure will be into the waste stream. There could be TSDF that are unable to operate the barrier fluid at a higher pressure than the pump. For example, a TSDF recycling pharmaceutical solvents may be unable to tolerate any contamination. These TSDF would then be required to have a closed-vent system to a control device. The degree to which the existing TSDF industry can accommodate DMS with the higher pressure barrier fluid is not known and would have to be determined on a case-by-case basis.

[e] Vendor cost for DMS systems ranged from $4,500 to $9,500 for an installed package pressurized recirculating system without a cooler for pumps in the 60- to 400-gal/min range. Total costs averaged nearly $15,000 (in 1988 $) per pump on a recent retrofit of 15 existing 150- to 200-gal/min pumps, with pressurized reservoir without recirculating barrier fluid and degassing vents, at a large chemical plant.

## TABLE 4-8. DUAL MECHANICAL SEAL SYSTEM ANNUALIZED COST PER PUMP

| Item | Basis | DMS annualized cost, $/pump in 1986 |
|---|---|---|
| Maintenance labor & material (MLM) | 4% TCI | = 390 |
| Overhead | 100% MLM | = 390 |
| Taxes, insurance, administrative, etc. | | = 390 |
| Capital recovery | 0.16275 x TCI | = 1,570 |
| | | 2,740 |

TCI = Total capital investment = $9,650 (see Table 4-7).

percent can be expected for valves in gas and light-liquid service, respectively. However, in some cases there are more stringent, technologically feasible controls. For example, leakless equipment for valves, such as diaphragm and sealed bellows valves, when usable, eliminates the seals that allow fugitive emissions; thus, control efficiencies in such cases are virtually 100 percent as long as the valve does not fail (see Section 4.1.6).

With regard to leakless valves, the applicability of these types of valves is limited for TSDF, as noted by EPA in the preamble to the final rules. The EPA does not believe that leakless valves can be used in an environmentally sound manner on the wide variety of operating conditions and chemical constituents found nationwide in TSDF waste streams, many of which are highly corrosive. The use of these leakless technologies must be specified on a case-by-case basis only. The design problems associated with diaphragm valves are the temperature and pressure limitations of the elastomer used for the diaphragm. It has been found that both temperature extremes and process liquids tend to damage or destroy the diaphragm in the valve. Also, operating pressure constraints will limit the application of diaphragm valves to low-pressure operations such as pumping and product storage facilities. There are two main disadvantages to sealed bellows valves. First, they are, for the most part, only available commercially in configurations that are used for on/off valves rather than for flow control. As a result, they cannot be used in all situations. Second, the main concern associated with this type of valve is the uncertainty of the life of the bellows seal. The metal bellows are subject to corrosion and fatigue under severe operating conditions. Corrosivity is influenced by temperature and such factors as the concentration of corrosive constituents and the presence of inhibiting or accelerating agents. Corrosion rates can be difficult to predict accurately; underestimating corrosion can lead to premature and catastrophic failures. Even small amounts (trace quantities) of corrosives in the stream can cause corrosion problems for sealed bellows valves; these tend to aggressively attack the metal bellows at crevices and cracks (including welds) to promote rapid corrosion. Sealed bellows valves particularly are subject to corrosion because the bellows is an extremely thin metallic membrane.

The durability of metal bellows is highly questionable if the valve is operated frequently; diaphragm and bellows valves are not recommended in the technical literature for general service. The EPA does not believe that the application of sealed bellows, diaphragm, or pinch valves is technologically feasible for all TSDF valve conditions, nor is the EPA convinced that their application would lead to a significant reduction in emissions and health risks. Valve sizes, configurations, operating temperatures and pressures, and service requirements are some of the areas in which diaphragm, pinch, and sealed bellows valves have limitations that restrict service. With regard to the emission reductions achieved by sealed bellows, diaphragm, and pinch valve technologies, these valves are not totally leakless. The technologies do eliminate the conventional seals that allow leaks from around the valve stem; however, these valves do fail in service from a variety of causes and, when failure occurs, these valves can have significant leakage. This is because these valves generally are not backed up with conventional stem seals or packing. The EPA is reevaluating the control efficiencies assigned to these technologies. The EPA has requested in a separate FEDERAL REGISTER notice (54 FR 30228, July 19, 1989) additional information on the applicability and use of leakless valves at TSDF, and this information will be used to further determine the applicability of leakless valves to TSDF waste streams and their potential for reduction of emissions and health risks. The cost of some leakless valves can be significantly higher (i.e., two to three times) than conventional valves in the same service.

### 4.6.3 Compressors, Pressure Relief Devices, Sampling Connections, and Open-Ended Lines

For compressors, the use of mechanical seals with barrier fluid systems and control of degassing vents (at 95 percent) are required by the Subpart BB standards. This is considered the most stringent control available for reduction of emissions from compressors. (Note: Compressors are not expected to be widely used at TSDF.) The use of control equipment (i.e., rupture disk systems or closed-vent systems to flares or incinerators) is the technical basis for controlling pressure relief devices. Closed purge sampling is the required control for sampling connection systems and is the most stringent feasible control. For open-ended valves or lines, the use of caps, plugs, or other equipment that will close the open end is required; these are the most stringent controls possible.

### 4.6.4 Flanges

Flanges are excluded from the routine LDAR monitoring requirements, but must be monitored if leaks are indicated (i.e., if the operators see, hear, or smell leaks from such equipment). Flanges may become fugitive emission sources when leakage occurs due to improperly chosen gaskets, poorly assembled flanges, or thermal stress resulting in the deformation of the seal between the flange faces. Although the average emission from flanges is roughly an order of magnitude less than that for valves (see Table 4-2), the number of these components at a TSDF may be such that, under unusual circumstances where additional emission control at a facility is necessary, flanges could be included in the LDAR routine monitoring program.

### 4.6.5 Other Considerations

4.6.5.1 Lower Leak Definition. The EPA has not concluded that an effective lower leak definition (i.e., <10,000 ppm) has been demonstrated as successful in achieving further emission reductions. Most data developed for current standards on leak repair effectiveness have applied 10,000 ppm as the leak definition and therefore do not indicate the effectiveness of repairs for leaks less than 10,000 ppm. This subject is being further examined by EPA, and additional guidance will be forthcoming.

4.6.5.2 Directed Maintenance. There is some evidence that directed maintenance is more effective than the conventional LDAR program; however, available data were insufficient to serve as a basis for requiring directed maintenance for all sources nationwide. In directed maintenance efforts, tightening of the packing is monitored simultaneously, and tightening is continued only to the extent that it reduces emissions. In contrast, "undirected" repair means repairs such as tightening valve packings without simultaneously monitoring results to determine whether the repair is increasing or decreasing emissions.

4.6.5.3 Lower Applicability Concentration. Subpart BB equipment leak standards apply to equipment (i.e., pumps, valves, and so on) that contain or contact hazardous waste streams that have a total organic concentration of at least 10 percent by weight. The 10-percent cutoff focuses control efforts on equipment most likely to cause significant adverse human health and environment impacts, i.e., equipment containing relatively concentrated organics and having the greatest potential for air emissions. Available data from the original equipment leak studies do not suggest that fugitive emissions from leaking equipment handling streams containing less than 10-percent organics are significant, nor have the control technologies been evaluated for equipment containing less than 10-percent organics. Therefore, a requirement to extend the LDAR program to equipment containing or contacting waste streams with less than 10-percent organics would be difficult to evaluate with regard to overall effectiveness. Such a requirement should be made only after a thorough evaluation on a case-by-case basis.

## 4.7 REFERENCES

1. Perry, P. H., and C. H. Chilton (eds). Chemical Engineers Handbook. 5th Edition. New York, McGraw-Hill. 1973. p. 6-5 - 6-26.

2. Henshaw, T. L. Reciprocating Pumps. New York, Van Nostrand Reinhold Company. 1987. p. 8-22.

3. Warring, R. H. Selection, Systems and Applications. 2nd Edition. Houston, Gulf Publishing Company. 1984. p. 93-97.

4. Reference 3.

5. Nasar, A. M. When to Select a Sealess Pump. Chemical Engineering. May 26, 1986. p. 85-89.

6. Merrick, C. A Guide to Selecting Manual Valves. Chemical Engineering. September 1, 1986. p. 52-64.

7. Erikson, D. G., and V. Kalcevic (IT Enviroscience). Fugitive Emissions. In: Organic Chemical Manufacturing. Volume 3: Storage, Fugitive and Secondary Sources. U.S. Environmental Protection Agency. Publication No. EPA-450/3-80-025. December 1980. Report 2, II-5.

8. Handbook of Valves, Piping and Pipelines. Houston, Gulf Publishing Company. 1982. p. 314, 315.

9. Templeton, H. C. Valve Installation, Operation and Maintenance. Chemical Engineering. 78(23):148. 1971.

10. Pilulik, A. Manually Operated Valves. Chemical Engineering. April 3, 1978. p. 121.

11. Kemplay, J. (eds.). Valve User's Manual. London, Mechanical Engineering Publications Ltd. British Valve Manufacturers Association. 1980. p. 51.

12. Reference 1, p. 6-58.

13. McFarland, I. Preventing Flange Fires. Chemical Engineering Progress. 65(8):59-61. 1969.

14. Nelson, W. E. Compressor Seal Fundamentals. Hydrocarbon Processing. 56(12):91-95. 1977.

15. Reference 14.

16. American Petroleum Institute. Centrifugal Compressors for General Refinery Service. API Standard 617, Fourth Edition. November 1979. p. 8.

17. Reference 14.

18. Reference 7, p. 11-7.

19. U.S. Environmental Protection Agency. Fugitive Emission Sources of Organic Compounds--Additional Information on Emissions, Emission Reductions, and Cost. Research Triangle Park, NC. Publication No. EPA-450/3-82-010. April 1982.

20. Reference 19.

21. Wetherold, R. G., L. P. Provost, and C. D. Smith (Radian Corporation). Assessment of Atmospheric Emissions from Petroleum Refining. Appendix B: Detailed Results. Prepared for U.S. Environmental Protection Agency. Research Triangle Park, NC. Publication No. EPA-600/2-80-075c. April 1980.

22. Blacksmith, J. R., et al. (Radian Corporation). Frequency of Leak Occurrence for Fittings in Synthetic Organic Chemical Plant Process Units. Problem-Oriented Report. Prepared for U.S. Environmental Protection Agency. Research Triangle Park, NC. Publication No. EPA-600/2-81-003. September 1980.

23. Langley, G. J., and L. P. Provost (Radian Corporation). Revision of Emission Factors for Nonmethane Hydrocarbons from Valves and Pump Seals in SOCMI Processes--Technical Note. Prepared for the U.S. Environmental Protection Agency. Research Triangle Park, NC. November 1981.

24. Reference 21.

25. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors. Research Triangle Park, NC. AP-41. February 1980.

26. Powell, D., et al. (PES, Inc.). Development of Petroleum Refinery Plot Plans. Prepared for U.S. Environmental Protection Agency. Research Triangle Park, NC. Publication No. EPA-450/3-78-025. June 1978.

27. Reference 19.

28. Teller, J. H. Advantages Found in On-Line Leak Sealing. Oil and Gas Journal. 77(29):54-59. 1979.

29. American Society of Mechanical Engineers. Part UG - General Requirements (Section VIII, Division I). In: ASME Boiler and Pressure Vessel Code, An American National Standard. New York, The Americal Society of Mechanical Engineers. 1977. p. 449.

30. Reference 21.

31. Williamson, H. J., et al. (Radian Corporation). Model for Evaluating the Effects of Leak Detection and Repair Programs on Fugitive Emissions. Technical Note. DCN 81-290-403-06-05-03. September 1981.

32. Reference 19.

33. Reference 19.

# 5.0 PROCESS VENTS

The process vent standards apply to vents emitting organic liquids, gases, or fumes that are released by mechanical or process-related means from hazardous wastes having a total organic concentration of 10 parts per million by weight (ppmw) and are specific to: (1) process vents on distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping operations and vents on combustion (i.e., incinerators, flares, boilers, and process heaters) and noncombustion (i.e., adsorbers and condensers) control devices serving these operations; and (2) process vents on tanks associated with distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping processes (e.g., distillate receivers, bottoms receivers, surge control tanks, separator tanks, and hot wells) if emissions from these process operations are vented through the tanks.

To comply with the process vent standards, the facility owner/operator is required to identify all process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, and stripping processes that are handling or processing hazardous wastes. The owner/operator must then determine which of these vents are affected by the process vent standard (i.e., those managing wastes with at least 10 ppmw total organics) and determine emission rates, through mass balance calculations or direct source tests, for each vent and for the entire facility from all affected vents. Facility emission rates must then be compared to the short- and long-term process vent emission rate limits (1.4 kg/h or 2.8 Mg/yr [3 lb/h or 3.1 short tons/yr]) to determine whether additional emission controls are required. If the process vent emission rate limit is exceeded, the owner/operator must install additional controls to reduce total facility process vent organic emissions to below the cutoff or reduce total facility process vent organic emissions by 95 percent. The standards for process vents do not require the use of any specific equipment or add-on control devices. Condensers, carbon adsorbers, enclosed combustion devices, and flares are applicable emission control equipment for the regulated processes, although the choice of control is not limited to these.

The rules for process vents contain requirements that specific control device operating parameters be monitored (Sections 264.1033 and 265.1033). Operating parameters are specified for condensers, carbon adsorbers, flares, incinerators, and other enclosed combustion devices. Although minimum operating conditions are identified for organic vapor destruction devices (e.g., incinerators and flares) to ensure 95 percent destruction, values or ranges of values for recovery device (i.e., carbon adsorbers and condensers for which the primary function is not that of recovering solvents or other organics for use, reuse, or sale) operating parameters cannot be specified on an industrywide basis. A recovery device must be designed for the particular application and monitored to ensure that it is being operated within design specifications. Proper design needed to achieve the emission rate limit or the 95-percent emission reduction performance requirement must be determined through engineering calculations, material balances, manufacturer/vendor certification (a documented agreement between the owner/operator and the vendor to guarantee the meeting of a standard of performance for a particular product), and/or emission testing, although the use of emission testing to determine compliance with efficiency requirements is expected to occur only rarely. The control device monitoring information is required to be recorded in the facility operating record (Sections 264.73 and 265.73).

The following sections of this chapter discuss process vents affected by the regulation, procedures to determine if process vent emission rates are below the cutoff limit, as well as control devices and control device operating parameters that must be monitored.

## 5.1 AFFECTED PROCESSES

The processes affected by the regulation are those associated with hazardous waste distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping operations and tanks serving these operations (e.g., distillate receivers, bottoms receivers, surge control tanks, separator tanks, and hot wells). These processes are typically vented to the atmosphere either directly (through a primary condenser or other vapor recovery device), through a vacuum-producing system, or through a tank such as a distillate receiver. Emission tests conducted by EPA have shown vent flow rates ranging from 0.0014 to 3.1 L/s (0.003 to 6.6 CFM) and mass organic emission rates ranging from 0.0015 to 34.8 Mg/yr (0.0017 to 38.4 ton/yr) at various hazardous waste units involving the distillation/separation operations specified in the rule. The following sections provide brief process descriptions and typical process vent configurations for the affected processes.

### 5.1.1 Distillation

Distillation is the most commonly used separation and purification procedure in refineries, solvent recovery systems, large organic chemical manufacturing plants, and TSDF. The fundamental operating principles for a distillation column are the same regardless of the application. This section briefly discusses some of the principles involved in distillation to provide a better understanding of the operating characteristics of distillation units.

Distillation is an operation separating one or more feed stream(s)* into two or more product streams, each product stream having component concentrations different from those in the feed stream(s). The separation is achieved by the redistribution of the components between the liquid- and vapor-phase as they approach equilibrium within the distillation unit. The more volatile component(s) concentrate in the vapor phase, while the less volatile components(s) concentrate in the liquid phase. Both the vapor and liquid phase originate predominantly by vaporization and condensation of the feed stream.

Distillation systems can be divided into subcategories according to the operating mode, the operating pressure, the number of distillation stages, the introduction of inert gases, and the use of additional compounds to aid separation. A distillation unit may operate in a continuous or a batch mode. The operating pressures can be below atmospheric (vacuum), atmospheric, or above atmospheric (pressure). Distillation can be a single-stage or a multistage process. Inert gas, especially steam, is often introduced to improve separation. Finally, compounds are often introduced to aid in distilling hard to separate mixture constituents (azeotropic and extractive distillation).

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*For batch distillation, the word "charge" should be used in place of "feed stream."

Batch distillation is a commonly used process for recovery of organics from hazardous wastes. Its principal use is for recovery of valuable organic chemicals for recycling or reuse and the re-refining of waste oil. It also can be applied to reduce the organic air emission potential of hazardous wastes by separating the volatile compounds from the wastes. Although it has been applied to aqueous wastes, it has been more typically applied to predominantly organic wastes (i.e., wastes with high organic concentrations).

The simplest form of distillation is a batch operation that consists of a heated vessel (called the pot), a condenser, and one or more distillate receiving tanks. This process is identical in principle to batch steam stripping except that the waste charge is heated indirectly instead of by direct steam injection. The waste material is charged to the pot and heated to boiling; vapors enriched in organics are then removed, condensed, and collected in receiving tanks. The distillation is continued to a cutoff point determined by the concentration of organics in the condensate or the concentration of organics remaining in the batch. A common modification is to add a rectifying column and some means of returning a portion of the distillate as reflux (see Figure 5-1). Rectification, or fractionation, is a multistage distillation operation that enables the operator to obtain products from the condensate that have a narrow composition range. At times, inert carriers (such as steam) are added to the distillation column. The light end vapors evolving from the column are condensed and collected in a distillate receiver tank. Part of the distillate is returned to the top of the column so it can fall countercurrent to the rising vapors. Different distillate cuts are made by switching to alternate receivers, at which time the operating conditions may be changed. If the distillate is collected as one product, the distillation is stopped when the combined distillate reaches the desired average composition.[1] Several references are available

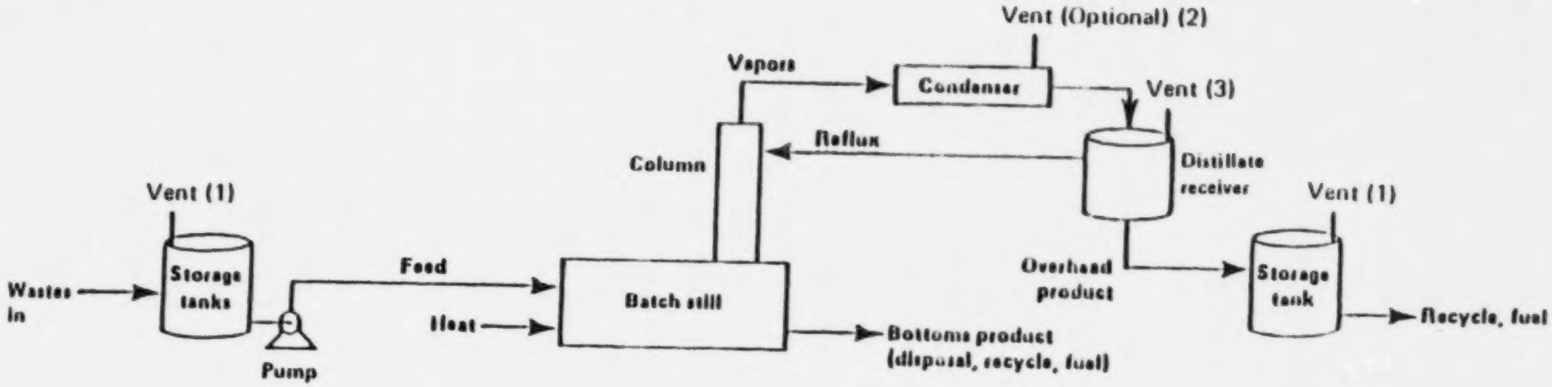

Figure 5-1. Schematic diagram of batch distillation with fractionating column.

Note: (1) Vent is not subject to the requirements of Subpart AA because the passage of liquids, gases, or fumes into the atmosphere is not caused by mechanical or process-related means.

(2) Vent is subject to the requirements of Subpart AA.

(3) Vent is subject to the requirements of Subpart AA only if uncondensed overhead vapors from the batch still operation are vented through the tank.

that discuss batch distillation design and operation at a temperature determined by the boiling point of the waste, which may increase with the time of operation. The distillation can be carried out under pressure or under vacuum. The use of a vacuum reduces the operating temperature and may improve product recovery, especially when decomposition or chemical reaction occurs at higher temperatures.

Batch distillation provides a means for removing organics from a waste matrix and recovering the organics by condensation for recycle, sale as product, or for fuel. The products and residues include the condensate that is enriched in organics and recovered, noncondensables that escape through the condenser vent, and the waste residue that remains in the pot. The noncondensables are composed of gases dissolved in the waste and very volatile organic compounds with relatively low-vapor-phase concentrations. The waste material after distillation may have been concentrated with high-boiling-point organics or solids that are not removed with the overhead vapors. These still bottoms may be a free-flowing liquid, a viscous slurry, or an organic material that may solidify upon cooling. If the waste material contains water, a separate aqueous phase may be generated with the condensate. This phase may be returned to the batch or processed with additional treatment to remove organics or other contaminants.

Batch distillation may be used for hazardous wastes that have a significant vapor-phase concentration of organics at the distillation temperature. If the waste can be pumped and charged to the still pot and the residue can be removed from the pot, then the waste is likely to be treatable for organic removal by this process. Such waste forms include dilute aqueous wastes (the operation would be similar to batch steam stripping), aqueous or organic sludges, or wastes with volatiles in a high-boiling-point organic solvent or oil. The batch distillation of sludges has not been demonstrated and evaluated in full-scale units; consequently, the processing of sludges in a batch distillation unit is subject to the same limitations described for the batch steam stripping of sludges (Section 5.1.3). Batch distillation has been used to remove organics from plating wastes, phenol from aqueous wastes, to recover and separate solvents, and to re-refine waste oils.[2,3] The applicability of batch distillation for a specific waste type can be evaluated by a simple laboratory distillation to assess potential organic recovery. As with other organic removal techniques, the process may require optimization in a pilot-scale or full-scale system for different types of wastes to determine operating conditions that provide the desired distillate composition or percent removal from the waste.

Batch stills usually are operated as a single equilibrium stage (i.e., with no reflux); consequently, the organic removal efficiency is primarily a function of the vapor/liquid equilibrium coefficient of the organics at distillation temperature and the fraction of the waste boiled over as distillate. The use of a rectifying section yields an overhead product with a composition that can be controlled by the operator. The removal efficiency for various waste types can be highly variable because of the dependence on both properties of the waste (e.g., organic equilibrium) and the operating conditions that are used.

### 5.1.2 Thin-Film Evaporation

Thin-film evaporators (TFE) are designed to promote heat transfer by spreading a thin layer of liquid on one side of a metallic surface while supplying heat to the other side.[4] The unique feature of this equipment is the mechanical agitator device, which permits the processing of high-viscosity liquids and liquids with suspended solids. However, if solid particles are large, a coarse filtration operation may be required to pretreat the waste stream going to the TFE. The mechanical agitator promotes the transfer of heat to the material by exposing a large surface area for the evaporation of volatile compounds and agitates the film to maintain the solids in suspension without fouling the heat transfer area. Heat can be supplied by either steam or hot oil; hot oils are used to heat the material to temperatures higher than can be achieved with saturated steam. TFE can be operated at atmospheric pressure or under vacuum as needed based on the characteristics of the material treated. A TFE operation is illustrated in Figure 5-2.

The two types of mechanically agitated TFE are horizontal and vertical. A typical unit consists of a motor-driven rotor with longitudinal blades that rotate concentrically within a heated cylinder. The rotating blade has a typical tip speed of 9 to 12 m/s (30 to 39 ft/s) and a clearance of 0.8 to 2.5 mm (0.032 to 0.098 in) to the outer shell. In a vertical design, feed

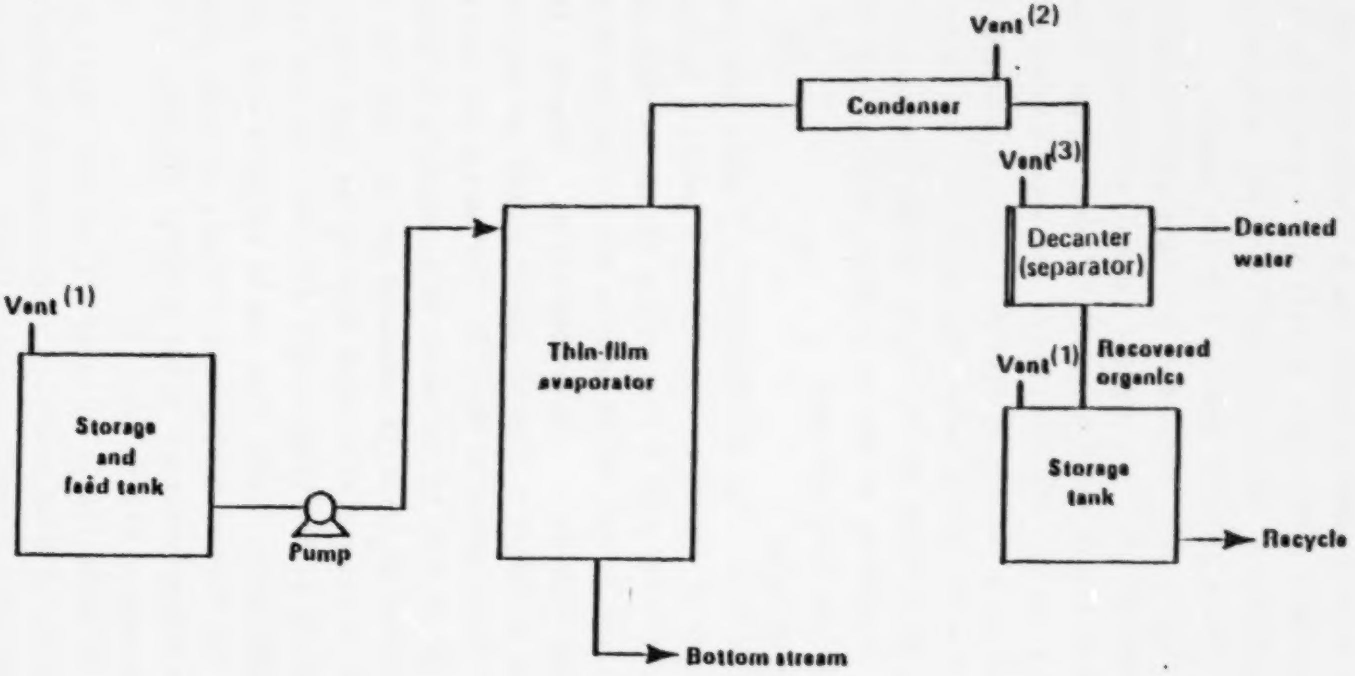

Figure 5-2. Schematic diagram of a thin-film evaporator system.

Note: (1) Vent is not subject to the requirements of Subpart AA because the passage of liquids, gases, or fumes into the atmosphere is not caused by mechanical or process-related means.

(2) Vent is subject to the requirements of Subpart AA.

(3) Vent is subject to the requirements of Subpart AA only if uncondensed overhead vapors from the thin-film evaporator operation are vented through the tank.

material enters the feed nozzle above the heated zone and is transported mechanically by the rotor and grating down a helical path on the inner heat transfer surface while the volatile compounds are volatilized and leave the evaporator on the top. The vapor-phase products from TFE are condensed in a condenser, and the bottom residues are collected for disposal.

TFE have been used widely for many years in a number of applications such as processing of chemicals, pharmaceuticals, plastics, and foods.[5] Because of their unique features, their use in chemical and waste material processing has expanded rapidly. The flexibility in operating temperature and pressure add potential to TFE for recovering low-boiling-point organics from a complex waste matrix.

Waste forms suitable for TFE treatment include organic liquids, organic sludge/slurry, two-phase aqueous/organic liquids, and aqueous sludges. TFE would not be an economical means of treating dilute aqueous waste because of the high water content in the waste.

### 5.1.3 Steam Stripping

Steam stripping involves the fractional distillation of volatile constituents from a less volatile waste matrix. Both batch and continuous steam stripping are commercially proven processes and have been commonly used to remove organics from aqueous streams such as process wastewater. Several references discuss steam stripping in detail, including a steam-stripping manual published by EPA,[6] descriptions of the theory and design procedures,[7-10] and descriptions of applicability to hazardous wastes.[11-14] The basic operating principle of steam stripping is the direct contact of steam with the waste, which results in the transfer of heat to the waste and the vaporization of the more volatile constituents. The vapor is condensed and separated (usually decanted) from the condensed water vapor. A simplified diagram of a steam stripping operation is shown in Figure 5-3.

Batch steam stripping may offer advantages at hazardous waste facilities because the unit can be operated in a manner most suitable for the particular batch of waste to be stripped. For example, the same unit may be used to remove volatiles from a batch of wastewater, from a waste containing solids, or from a high-boiling organic matrix. Batch stills may also be used if the material to be separated contains solids, tars, or resins that may foul or plug a continuous unit.

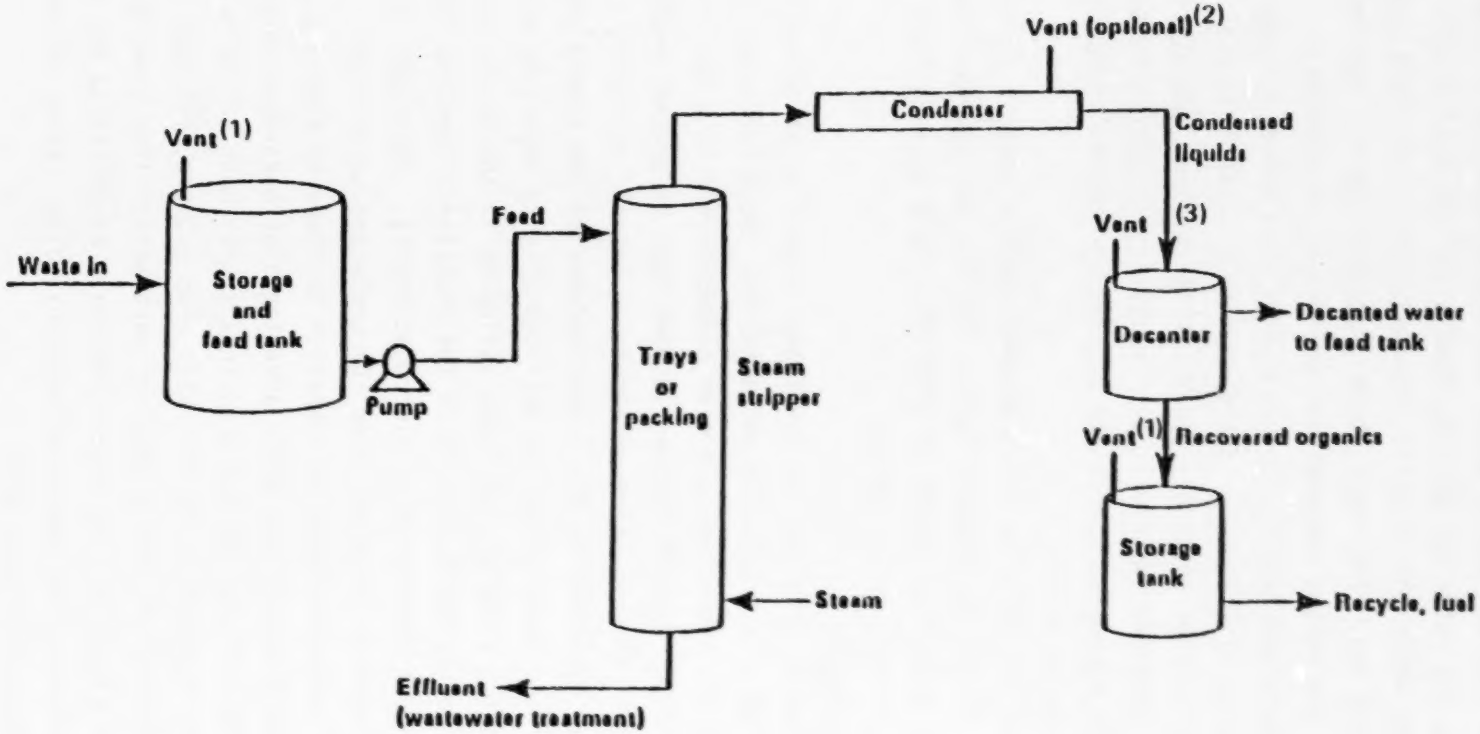

Figure 5-3. Schematic diagram of a steam stripping system.

Note: (1) Vent is not subject to the requirements of Subpart AA because the passage of liquids, gases, or fumes into the atmosphere is not caused by mechanical or process-related means.

(2) Vent is subject to the requirements of Subpart AA.

(3) Vent is subject to the requirements of Subpart AA only if uncondensed overhead vapors from the steam-stripping operation are vented through the tank.

The heat input rate and fraction boiled over can be varied for each waste composition to obtain the recovery or removal desired for the specific batch of waste. If the system is cleaned between batches, an aqueous waste stream may be generated from the rinse water. This rinse water may be added to a similar batch to be stripped, accumulated in a separate batch for treatment, or sent to a wastewater treatment (WWT) unit. However, wastewater may be generated from cleaning any organic removal or treatment system and would not be unique to batch operations.

Continuous steam stripping requires a feed stream that is a free-flowing liquid with a negligible solids content. Solids, including tars and resins, tend to foul the column trays or packing and heat exchangers. Consequently, wastes containing solids may require removal of the solids prior to processing through a continuous steam stripper. Unlike the batch operation, a continuous steam stripper requires a relatively consistent feed composition to maintain a consistent removal efficiency from the waste material.[15] A continuous steam stripper may offer cost advantages over a batch operation for applications in which there is little variation in the type of feed and for relatively high volumes of waste materials.

The products and residues from steam stripping include the condensed vapors (condensate), noncondensable gases, and the treated waste or effluent. The condensate usually is decanted to remove any separate organic layer from the aqueous layer. The aqueous condensate is then recycled to the feed stream. The separate organic layer may be recovered and reused as product or fuel. If the condensate is a single phase of water containing dissolved organics, then additional treatment of the condensate may be necessary for ultimate control of organics. Most commercial processes rely on the formation of a separate organic phase and decanting for economical removal and recovery of organics. Noncondensables in the overhead stream include gases dissolved in the waste material and very volatile compounds in low concentrations that are not condensed in the overhead system. The effluent from the steam stripper should be essentially free of the most volatile compounds; however, semivolatiles and compounds that are relatively nonvolatile may still be present in the stripper bottoms or effluent.

Preliminary treatment such as solids removal or pH adjustment is often used before wastewater is stripped in a continuous unit. Continuous steam stripping has been used routinely in the chemical industry to recover organics for recycle and to pretreat wastewater for organic removal prior to the conventional WWT process. Some common applications include recovery of ethylene dichloride, ammonia, sulfur, or phenol for recycle and removal of phenol, mercaptans, vinyl chloride, and other chlorinated compounds from wastewater.[16] Batch steam stripping appears to be more common at hazardous waste facilities because it is adaptable to different types of wastes that may be received in batches.[17] For any given waste type, pilot-scale evaluations or trials in the full-scale process may be required to optimize the operating conditions for maximum removal at the lowest cost.

Removal efficiencies on the order of 95 to 100 percent are achievable for volatile compounds such as benzene, toluene, and one- or two-carbon chlorinated compounds.[18,19] Batch operations usually provide a single equilibrium stage of separation, and the removal efficiency is determined essentially by the equilibrium coefficient and the fraction of the waste distilled. The efficiency of a continuous system is related to the equilibrium coefficient and the number of equilibrium stages, which is determined primarily by the number of trays or height of packing. The organic removal efficiency also is affected by the steam input rate, column temperatures, and, in some cases, the pH. Temperature affects the solubility and partition coefficient of the volatile compound. The liquid pH also may affect the solubility and treatability of specific compounds, such as phenol. In principle, the removal efficiency in a multistage system can be designed to achieve almost any level. In practice, removal efficiencies are determined by practical limits in the column design (such as maximum column height or pressure drop) and cost. Consequently, steam stripping is difficult to characterize in terms of maximum achievable performance with respect to organic concentration in the treated waste.

### 5.1.4 Solvent Extraction[20,21]

Solvent extraction is a process whereby a dissolved or adsorbed substance is transferred from a liquid phase to a solvent that preferentially dissolves that substance. When the waste to be treated is a liquid, the process may be called liquid-liquid extraction. The substance transferred is the solute; the treated effluent is referred to as the raffinate; and the solute-rich solvent phase is called the extract. For the process to be effective, the extracting solvent must be immiscible in the liquid and differ in density so that gravity separation is possible and there is minimal contamination of the raffinate with solvent. Solvents that are used include benzene, toluene, chloroform, methylene chloride, isopropyl ether, and butylacetate.

Solvent extraction can be performed as a batch process or by the contact of the solvent with the feed in staged or continuous contact equipment. There are two main classes of solvent extraction equipment--tanks in which mechanical agitation is provided for mixing of the two phases, and tanks in which the mixing is done by the flow of the fluids themselves (e.g., a spray tower, packed tower, or sieve plate tower). Liquid-liquid extraction results in two streams, the raffinate and the extract, which usually require further treatment. If aqueous, the raffinate may be contaminated with small quantities of both the solute and the solvent. These may have to be removed by carbon adsorption. Solvent is typically recovered from the extract by distillation, leaving a concentrated solute-solvent waste stream for incineration or disposal. Distillation processes have potential organic emissions from condenser vents, accumulator tank vents, and storage tank vents. A schematic diagram of a solvent extraction system is illustrated in Figure 5-4.

The solvent extraction process is most suitable for the pretreatment of aqueous waste streams with high levels of organic constituents. It is a proven method for removing phenol, acetic acid, salicylic (and other hydroxy aromatic) acids, and petroleum oils from aqueous solutions. Solvent extraction is used to remove organic contaminants from aqeous wastes in several industries including petroleum refining, organic chemicals manufacturing, pulp and paper, and iron and steel. Solvent extraction is a limited technology in that it is almost always necessary to further treat the raffinate and/or the extract. Other limitations include the difficulty in finding a suitable solvent low in cost, high in extraction efficiency, and easily separable from the extracted substance. Though not as popular as distillation, stripping, or carbon adsorption due to its higher cost, solvent extraction is widely used to recover valuable solvents. Typical removal efficiencies of solvent extraction range from 80 percent to close to 100 percent.

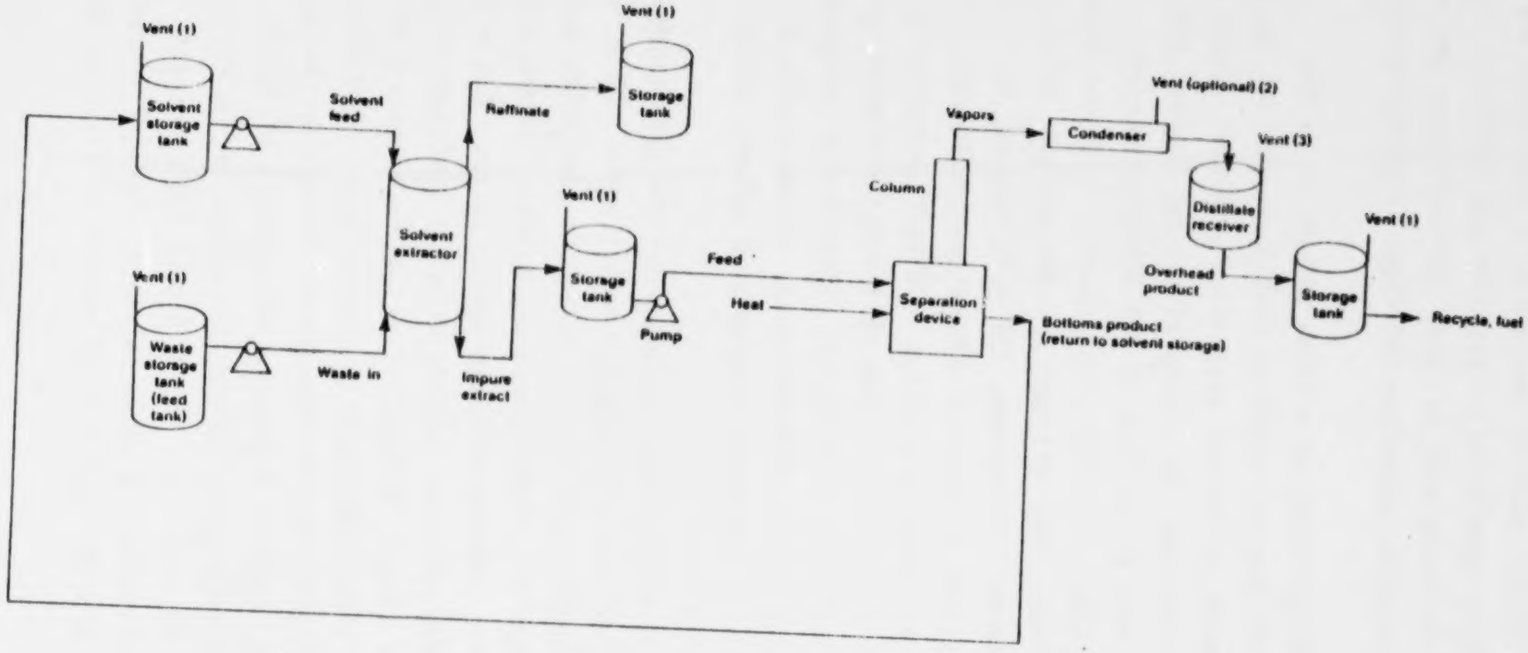

Figure 5-4. Schematic diagram of solvent extraction system.

Note: (1) Vent is not subject to the requirements of Subpart AA because the passage of liquids, gases, or fumes into the atmosphere is not caused by mechanical or process-related means.

(2) Vent is subject to the requirements of Subpart AA.

(3) Vent is subject to the requirements of Subpart AA only if uncondensed overhead vapors from the batch still operation are vented through the tank.

### 5.1.5 Air Stripping

Air stripping is a process that uses forced air to remove volatile compounds from a less volatile liquid. The contact between air and liquid can be accomplished in spray towers, mechanical or diffused-air aeration systems, and packed towers.[22] The focus of this section is on packed tower air strippers because the vapor-laden air can be sent to a control device for ultimate control of organic air emissions. In packed towers, the liquid to be treated is sprayed into the top of a packed column and flows down the column by gravity. Air is injected at the bottom of the column and rises countercurrent to the liquid flow. The air becomes progressively richer in organics as it rises through the column and is sent to a control device to remove or destroy organics in the airstream. See Figure 5-5 for a schematic of a typical air stripping system with gas-phase organic emission control.

The principle of operation is the equilibrium differential between the concentration of the organics in the waste and the air with which it is in contact. Consequently, compounds that are very volatile are the most easily stripped. The packing in the column promotes contact between the air and liquid and enhances the mass transfer of organics to the air. The residues from air stripping include the organic-laden air and the water effluent from the air stripper. This effluent will contain very low levels of the most volatile organic compounds; however, semivolatile compounds that are not easily air stripped may still be present. The process does not offer a significant potential for recovery and reuse of organics. Condensers generally are not used to recover the stripped organics because of the large energy requirements to cool the large quantity of noncondensables (primarily air) and to condense the relatively low vapor-phase quantities of organic compounds.

Air stripping has been used primarily on dilute aqueous waste streams with organic concentrations that range from a few parts per billion to hundreds of parts per million. The feed stream should be relatively free of solids to avoid fouling in the column; consequently, some form of solids removal may be required for certain aqueous hazardous wastes. In addition, dissolved metals that may be oxidized to an insoluble form should be removed. Equipment may be designed and operated to air-strip organics from sludges and solids in a batch operation; however, this application has not

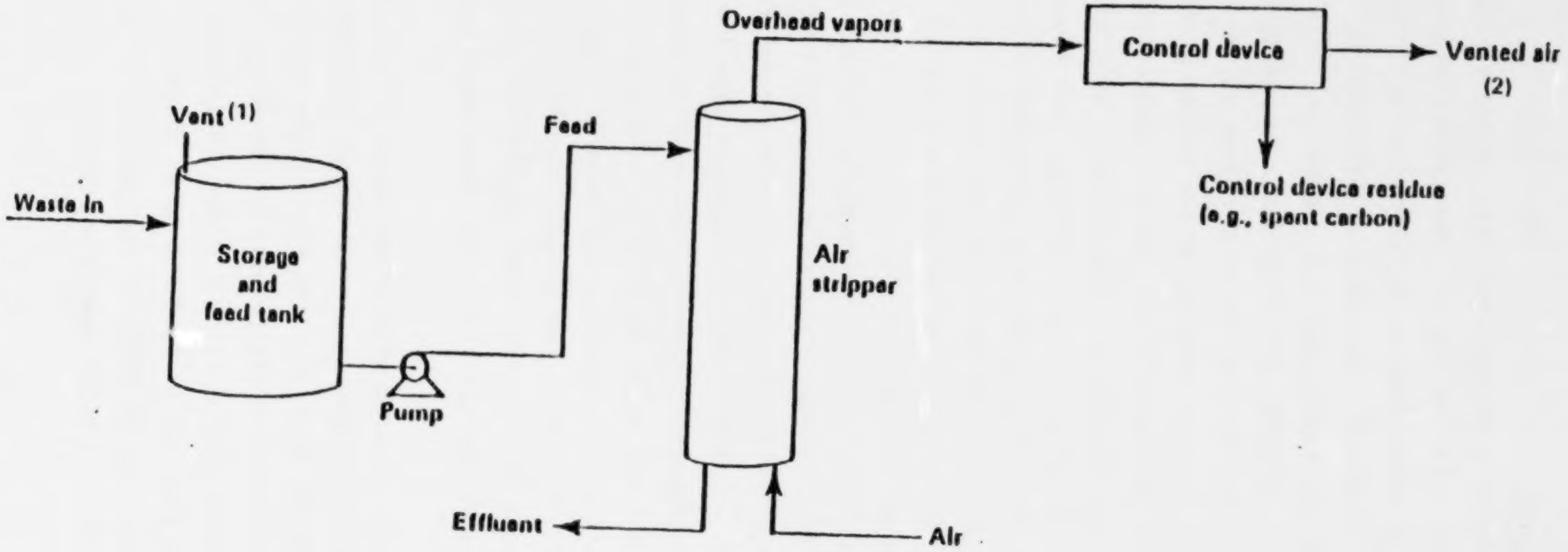

Figure 5-5. Schematic diagram of an air stripping system.

Note: (1) Vent is not subject to the requirements of Subpart AA because the passage of liquids, gases, or fumes into the atmosphere is not caused by mechanical or process-related means.

(2) Vent is subject to the requirements of Subpart AA.

been demonstrated extensively and is not a common practice. The major industrial application of air stripping has been in the removal of ammonia from wastewater.[23] In recent years, the use of air strippers has become a widely used technology in the removal of volatile compounds from contaminated ground water.[24,25]

Packed towers can achieve up to 99.9 percent removal of volatiles from water.[26] The major factors affecting removal efficiency include the equilibrium between the organics and the vapor phase (usually measured by Henry's law constant for dilute aqueous wastes) and the system's design, which determines mass transfer rates. Removal efficiency increases as the equilibrium coefficient increases; consequently, the extent of removal is strongly affected by the type of waste and the volatility of the individual organic constituents. Mass transfer rates (and removal efficiency) are also a function of the air-to-water ratio, height of packing, and type of packing.[27] The operating temperature is also an important variable that affects efficiency because of its direct effect on the vapor/liquid equilibrium. Higher temperatures result in higher vapor-phase concentrations of organic and higher removal rates. Air strippers have operational difficulties in freezing weather that may require heating the input waste stream, heating and insulating the column, or housing the operation inside an enclosure. Air strippers are typically designed to remove key or major constituents. Compounds more volatile than the design constituent are removed at or above the design efficiency, and less volatile compounds are removed at a lower efficiency.

The air leaving the stripping column usually is treated by incineration (thermal or catalytic) or carbon adsorption. The choice between incineration and carbon adsorption depends on the specific conditions at the facility. For example, high relative humidity in the airstream leaving the air stripper may adversely affect the adsorption capacity of a carbon bed. This problem could be avoided by choosing incineration. However, if the airstream contains chlorinated organics, the incinerated airstream may need to be scrubbed to remove HCl, leading to higher costs. In this case, it might be better to choose carbon adsorption and design the system to avoid potential humidity problems.

## 5.2 PROCESS VENT EMISSION RATE CUTOFF DETERMINATION

After identifying all affected process vents, the owner/operator must determine whether the affected process vent's emission rate is below the emission rate limits established by the regulation. To make this decision, the owner/operator must determine emission rates for each vent and for the entire facility through mass balance calculations or direct source test and compare the rates to the short- and long-term process vent emission rate limits (1.4 kg/h or 2.8 Mg/yr [3 lb/h or 3.1 short tons/yr]). Example applications of the emission cutoff for process vents are presented in Tables 5-1 and 5-2.

Alternative methods of estimating facility process vent emissions are discussed in the following sections.

### 5.2.1 Mass Balance

Losses or emissions from any process can be estimated from an accurate mass balance. Emission estimates, however, to determine if compliance has been met should be based on the waste streams with the highest emission potential allowed under the permit (or if no permit has been issued, allowed under interim status). If all inlet and outlet process streams are precisely characterized with regard to flow rates, composition, and physical properties, any difference between the total known amount of material entering the system and that known to be leaving would be emissions. This can be expressed as:

$$\text{Mass emissions} = \text{Mass in} - \text{Mass out} \quad . \qquad (5\text{-}1)$$

In practice, precise measurements of material volumes, flow rates, and characteristics are often difficult to obtain. Most flow rates and material rate measurements in chemical processing are made in terms of volume. Thus, fluid densities must be known to convert volumetric measurements to mass flows. A liquid material balance can be expressed as:

$$E_i = \sum_j L_j W_{i,j} P_j - \sum_k L_k W_{i,k} P_k \ , \qquad (5\text{-}2)$$

where:

$E_i$ = Emission rate (losses) of component i, lb/h

$L_j$ = Volumetric flow rate of inlet stream j, gal/h

TABLE 6-1. EXAMPLE APPLICATION #1 OF EMISSION CUTOFF FOR PROCESS VENTS[a]

| | Emission rate (ER) in lb/h for vents on the following equipment | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Storage tank[b] | | Condenser serving a steam stripper[c] | | Decanter serving a condenser serving a thin-film evaporator[d] | | Carbon adsorber serving a steam stripper[c] | | Thermal incinerator serving a condenser serving a batch still[c] | | Condenser serving a distillation operation serving a solvent extractor[c] | | Total facility emissions (lb/h)) (subject to the require-ments of Subpart AA) | |
| Facility | ER/ source | No. of sources | ER/ source | No. of sources | ER/ source | No. of sources | ER/ source | No. of sources | ER/ source | No. of sources | ER/ source | No. of sources | | Action required |
| Example facility A | 0.08 | 7 | | | 0.49 | 2 | | | 1.2 | 1 | | | 2.18 | Total facility emissions below cutoff; therefore, no action required. |
| Example facility B | 0.11 | 9 | 0.04 | 2 | | | | | | | 8.3 | 1 | 9.98 | Total facility emissions above cutoff; but can control a single vent (e.g., condenser serving distillation operation serving a solvent extractor) to get below limit. |
| Example facility C | 0.15 | 41 | | | 10.6 | 7 | 1.3 | 7 | | | 3.1 | 5 | 98.8 | Total facility emissions above cutoff; but will reduce facility emissions by 95%. |

ER = emission rate.

[a] Facility emission cutoff for process vents is 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 short tons/yr) or 95% weight percent reduction in facility emissions.

[b] Vent is not subject to the requirements of Subpart AA because the passage of liquids, gases, or fumes into the atmosphere is not caused by mechanical or process-related means. (The emissions from this vent are not included in the total facility emissions subject to the requirements of Subpart AA.)

[c] Vent is subject to the requirements of Subpart AA.

[d] Vent is subject to the requirements of Subpart AA because uncondensed overhead vapors from the operation are vented through the tank.

TABLE 5-2. EXAMPLE APPLICATION #2 OF EMISSION CUTOFF FOR PROCESS VENTS[a]

| Facility | Emission rate (ER) in lb/h for vents on the following equipment | | | | | | | | | | | | Total facility emissions, ton/yr (subject to the requirements of (subpart AA) | Action required |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Storage tank[b] | | | Condenser serving a steam stripper[c] | | | Decanter serving a condenser serving a thin-film evaporator[d] | | | Thermal incinerator serving a condenser serving a batch still[c] | | | | |
| | ER/ source | Operating h/yr | No. of sources | ER/ source | Operating h/yr | No. of sources | ER/ source | Operating h/yr | No. of sources | ER/ source | Operating h/yr | No. of sources | | |
| Example facility A | 0.08 | 8,760 | 7 | | | | 0.49 | 2,000 | 2 | 1.2 | 2,000 | 1 | 2.27 | Total facility emissions below cutoff; therefore, no action required. |
| Example facility B | 0.11 | 8,760 | 9 | 0.84 | 2,000 | 2 | 8.3 | 2,000 | 1 | | | | 10.4 | Total facility emission above cutoff; but can control a single vent (e.g., decanter serving a thin-film evaporator) or reduce operating hours to get below the limit. |
| Example facility C | 0.15 | 8,760 | 41 | 2.3 | 4,160 | 6 | 7.1 | 4,160 | 5 | 1.9 | 4,160 | 2 | 100 | Total facility emissions above cutoff; but must reduce facility emissions by 96% (to 5.3 ton/yr) to comply. |

ER = emission rate.

Sample calculation:

(Example facility A) (0.49 lb/h/source) (2,000 h/yr) (2 sources) (1 ton/2,000 lb) + (1.2 lb/h/source) (2,000 h/yr) (1 source) (1 ton/2,000 lb) = 2.27 ton/yr.

[a] Facility emission cutoff for process vents is 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 short tons/yr).

[b] Vent is not subject to the requirements of Subpart AA because the passage of liquids, gases, or fumes into the atmosphere is not caused by mechanical or process-related means. (The emissions from this vent are not included in the total facility emissions subject to the requirements of Subpart AA.)

[c] Vent is subject to the requirements of Subpart AA.

[d] Vent is subject to the requirements of Subpart AA because uncondensed overhead vapors from the operation are vented through the tank.

$L_k$ = Volumetric flow rate of outlet stream k, gal/h

$W_{i,j}$ = Weight fraction of component i in inlet stream j

$W_{i,k}$ = Weight fraction of component i in outlet stream k

$P_j$, $P_k$ = Density of liquid stream j and k, respectively, lb/gal.

All parameters in Equation 5-2 are measured. (For guidance on sample-taking, see Chapter 6.0.) The emissions can also be expressed as a percentage of the total organic throughput of the process.

### 5.2.2 Emission Test

A direct source or performance emission test is an alternative means of determining the emission rate for a process vent. The direct source emission test should be conducted when wastes and process operating conditions are at maximum emission potential. Methods for measuring emissions from ducted sources are well documented.[28] The approach requires that the volumetric flow rate of the gas be determined, typically as measurements of velocity and duct cross-sectional area, and that the gas organic concentration be measured. The emission rate for each organic constituent can then be calculated as:

$$E_i = C_i U A \quad , \qquad (5\text{-}3)$$

where:

$E_i$ = Emission rate of component i, µg/s

$U$ = Gas velocity through vent, m/s

$C_i$ = Concentration of component i in vent gas, $\mu g/m^3$

$A$ = Cross-sectional area of vent, $m^2$.

All parameters in Equation 5-3 are measured directly.

Emission testing is discussed in Chapter 6.0. Table 6-7 lists several flow measuring methods that could be considered for the measurement of the flow rate in the process vent stream of concern. In addition, Section 6.1.2 discusses the measurement of the organic content of the waste stream gases (the preferred method of analysis is EPA Method 18).

Once the process vent organic content and gas flow rate have been measured, these data can be used to calculate the emission rate. The hourly emission rate (kg/h) is equal to the flow rate ($m^3/s$) multiplied by the organic concentration (ppmv), the average molecular weight (kg/g mole), and appropriate conversion factors (see Table 6-8). The emission rate for the hourly value should be based on the maximum expected emission from the source. Similarly, the yearly emission rate is based on the maximum total emissions expected from the facility; therefore, the calculation will have to be based on the maximum hourly emission and the yearly hours of operation.

## 5.3 VENT CONTROLS

If the total facility process vent emission rate for hourly or yearly emissions exceeds the limits in the regulation, then controls will have to be used to reduce emissions below the limits or, if the emission rate limits cannot be attained, by 95 percent or greater of the total vented mass. These controls or control devices used to reduce the emissions from the process vents affected by the regulation are by definition enclosed combustion devices, vapor recovery systems, or flares, though process vent controls are not limited to these devices. Any device for which the primary function is to recover or capture solvents or other organics for use, reuse, or sale (e.g., a primary condenser on a solvent recovery unit) is considered to be a component of the process rather than a control device. The emission reduction attained by a device that is part of the process should not be included in the emission reduction calculation for the purpose of determing compliance.

The vented emission must be transported to a control device by a "closed-vent system." This system has already been discussed in the equipment leak section because all "closed-vent systems" must be monitored for leaks. The control device efficiency must be determined by calculating the mass of organics entering the control device and the mass of organics exiting the same control device.

As previously mentioned, any engineering judgment concerning control device efficiency may put the owner/operator at risk if that judgment proves erroneous. A performance test, if used to determine efficiency, will consist of measuring the organic content and gas flow rate into and out of the control device. The test procedures that have been referenced for gas-phase organic concentration measurement and velocity (flow rate) measurement are appropriate for the performance test. A performance test should include at least three 1-h test periods under conditions that would exist when the hazardous waste management unit is operating at the highest load or capacity level reasonably expected to occur. The organic reduction efficiency would be estimated for each 1-h period, and an average of the three values would represent the system performance at maximum conditions.

In addition to the performance test, the owner/operator will be required to monitor continuously certain operational parameters of the control device to ensure continued attainment of design organic reduction efficiency. Table 6-8 lists possible controls, monitoring requirements, and monitoring methods. The relationship of the organic reduction performance and control device operating parameter can be established during the performance test or through engineering calculations, material balances, or manufacturer/vendor certification (a documented agreement between the owner/operator and the vendor to guarantee the meeting of a standard of performance for a particular product).

The owner/operator must keep a logbook that provides data on the specified control device operating parameters that are required to be monitored under Subpart AA of the standards for process vents. Periods when monitoring indicates that control device operating parameters exceed established tolerances set forth by the regulation must also be recorded and reported to the Regional Administrator (see Section 7.2.2, "Process Vent Recordkeeping Requirements," for information regarding exceedances). This log should also contain information and data identifying all affected process vents, annual throughput and facility operating hours of each affected unit, estimated emission rates for each affected vent and for the overall facility, and the approximate location within the facility of each affected unit.

### 5.3.1 Condensation

Condensation is a process of converting all or part of the condensable components of a vapor phase into a liquid phase. This is achieved by the transfer of heat from the vapor phase to a cooling medium. If only a part of the vapor phase is condensed, the newly formed liquid phase and the remaining vapor phase will be in equilibrium. In this case, equilibrium relationships at the operating temperatures must be considered. The heat removed from the vapor phase should be sufficient to lower the vapor-phase temperature to (or below) its dewpoint temperature (temperature at which first drop of liquid is formed).

Condensation devices are of two types: surface condensers and contact condensers.[29] Surface condensers generally are shell-and-tube type heat exchangers. The coolant and the vapor phases are separated by the tube wall, and they never come in direct contact with each other (see Figure 5-6). Vapors are cooled in contact condensers by spraying relatively cold liquid directly into the gas stream. The coolant is often water, although in some situations another coolant may be used. Most contact condensers are simple spray chambers, like the one pictured in Figure 5-7.

Contact condensers are, in general, less expensive, more flexible, and more efficient in removing organic vapors than surface condensers. On the other hand, surface condensers may recover marketable condensate and minimize waste disposal problems. Often, condensate from contact condensers cannot be reused and may require significant wastewater treatment prior to disposal. Surface condensers must be equipped with more auxiliary equipment and have greater maintenance requirements. Surface condensers are considered in the discussion of control efficiency and applicability because they are used more frequently in the hazardous waste management industry.

The major equipment components used in a typical surface condenser system for organic removal are shown in Figure 5-8. This system includes (1) shell- and-tube dehumidification equipment (2) shell-and-tube heat exchanger (3) refrigeration unit, and (4) recovered organic storage tanks and operating pumps. Most surface condensers use a shell-and-tube type of heat exchanger to remove heat from the vapor.[30] As the coolant passes through the tubes, the organic vapors condense outside the tubes and are recovered. The coolant used depends on the saturation temperature of the organic vapor stream. Chilled water can be used down to 7 °C (45 °F), brines to -34 °C (-30 °F), and chlorofluorocarbons below -34 °C (-30 °F).[31] Temperatures as low as -62 °C (-80 °F) may be necessary to condense some organic vapor.[32]

The design of surface condensers involves calculating the rate of heat transfer through the wall of the exchanger per unit time, its "duty," or

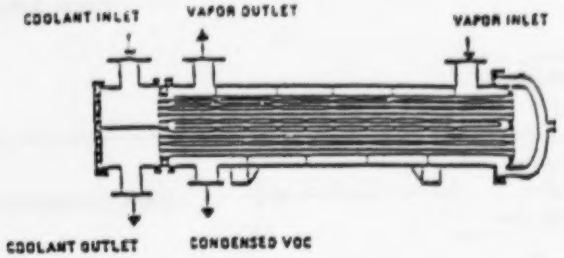

Figure 5-6. Schematic diagram of a shell-and-tube surface condenser.

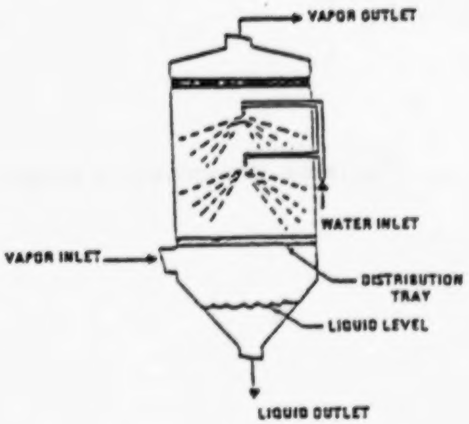

Figure 5-7. Schematic diagram of a contact condenser.

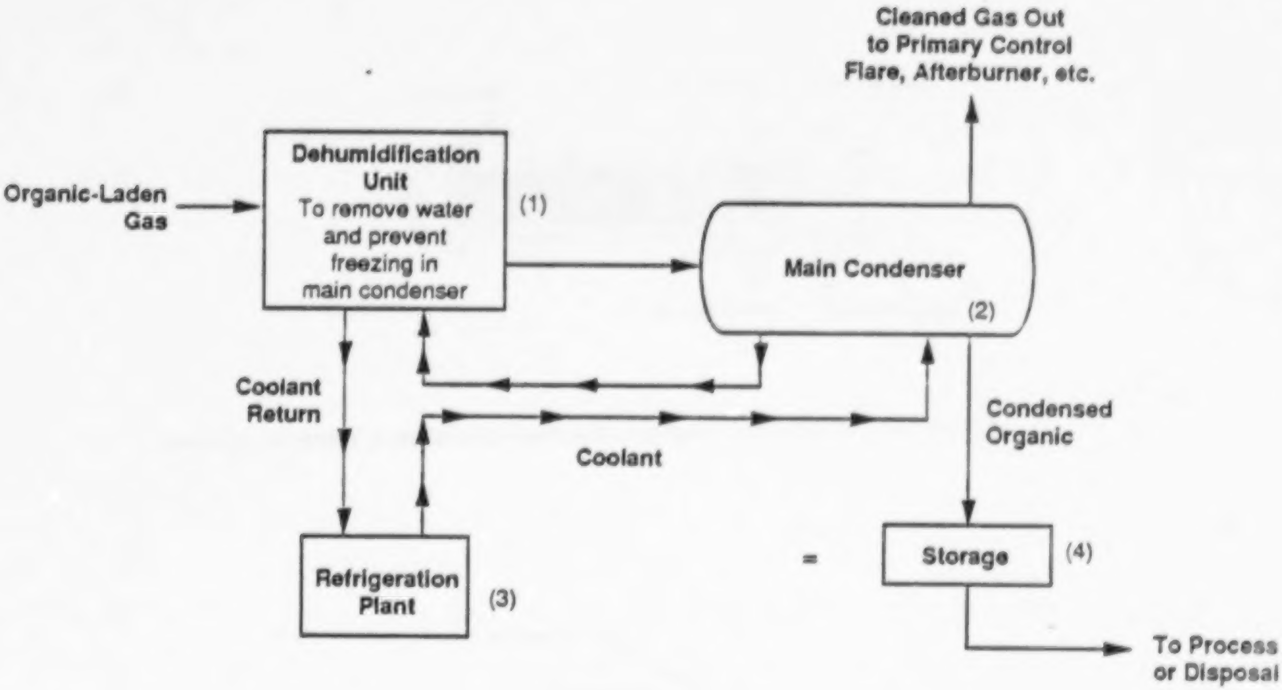

Figure 5-8. Condensation system.

calculating the heat-transfer area. The rate of heat transfer for a surface condenser is governed by the following relationship:

$$Q = U_o A T_m \quad \text{or} \quad A = \frac{Q}{U_o T_m} , \tag{5-4}$$

where:

Q = Total heat load/rate of heat transfer, Btu/h

$U_o$ = Overall heat-transfer coefficient, Btu/h °F $ft^2$

$T_m$ = Mean temperature difference, °F

A = Heat transfer surface area, $ft^2$.

If the heat-transfer area, the overall heat-transfer coefficient and the mean temperature difference are known, the condenser duty can easily be calculated. (See Appendixes C and D for sample calculations on the size and rate of heat transfer of a condenser; for an analysis of the effect of concentration on condenser efficiency, see Appendix E.) Calculation of heat-transfer coefficients, a tedious step in definitive design, is avoided in predesign evaluations where approximate values are adequate. An extensive tabulation of typical overall coefficients, based on industrial practice, is found in Reference 1 (pp. 10-39 to 10-42). The appropriate mean temperature difference can be calculated using the following expression:

$$\text{MTD} = T_m = \frac{(T_{hi} - T_{co}) - (T_{ho} - T_{ci})}{\ln [(T_{hi} - T_{co})/(T_{ho} - T_{ci})]} , \tag{5-5}$$

where:

$T_{hi}$ = Inlet temperature of hot fluid, K (°F)

$T_{ho}$ = Outlet of hot fluid

$T_{ci}$ = Inlet of cold fluid

$T_{co}$ = Outlet of cold fluid.

If flow in the exchanger is not truly countercurrent, an appropriate correction factor must be applied.[33] In practice, the vapor stream will contain multicomponents, air and at least one other gas, thus complicating the design procedures.

To ensure that the condenser is operated and maintained within design specifications, 40 CFR 264.1033(f) and 265.1033(f) require the owner/operator to monitor and inspect each condenser required to comply with the facility process vent emission rates by implementing the following requirements:

- Install, calibrate, maintain, and operate according to the manufacturer's specifications a flow indicator that provides a record of vent stream flow to the control device at least once every hour. The flow indicator sensor shall be installed in the vent stream at the nearest feasible point to the control device inlet, but before being combined with other vent streams.
- Install a monitoring device equipped with a continuous recorder to measure the concentration level of the organic compounds in the exhaust vent stream from the condenser; or
- Install a temperature monitoring device equipped with a continuous recorder. The device shall be capable of monitoring temperature at two locations and have an accuracy of ±1 percent of the temperature being monitored in degrees Celsius or ±0.5 °C, whichever is greater. One temperature sensor shall be installed at a location in the exhaust vent stream from the condenser, and a second temperature sensor shall be installed at a location in the coolant fluid exiting the condenser.

A secondary parameter that can be monitored to give an indication of the operating or removal efficiency is the quantity of organic removed over time.

The volatile organic removal efficiency for a condenser is dependent upon the gas stream organic composition and concentrations as well as the condenser operating temperature. Condensation can be an effective control device for gas streams having high concentrations of organic compounds with high boiling points. However, condensation is not effective for gas streams containing low organic concentrations or composed primarily of low-boiling-point organics. At these conditions, organics cannot readily be condensed at normal condenser operating temperatures. This point is demonstrated in the results of a field evaluation of a condenser used to recover organics from a steam stripping process treating wastewater at a plant manufacturing ethylene dichloride and vinyl chloride monomer. The measured condenser removal efficiencies for specific organic constituents in the controlled vent stream ranged from a high value of 99.5 percent for 1,2-dichloroethane to a low value of 6 percent for vinyl chloride.

### 5.3.2 Combustion Equipment

There are basically three types of combustion equipment used in controlling gaseous emissions: flares, thermal oxidizers (thermal incinerators, boilers or process heaters), and catalytic oxidizers (catalytic incinerators). Inside a flare, a flame is used to oxidize all the combustible material. In a thermal oxidizer, combustible gases pass over or around the burner flame first and then into a chamber where the gas flow rate is decreased, thus allowing an adequate time for complete oxidation. Catalytic oxidizers are similar to thermal oxidizers. The major difference between the two is that, after the combustible gases pass through the flame area, the gas is sent through a catalyst bed that promotes oxidation at temperatures lower than the ones necessary in a thermal oxidizer. This reduces fuel usage, and lighter construction can be used in catalytic units. The main problem in catalytic oxidation is the reduction or loss of catalyst activity due to fouling by particulate matter or suppression or poisoning by sulfur and halogen compounds or certain metals. Control devices used to reduce TSDF process vent emissions would be subject to these contaminants in the waste gas stream; therefore, thermal oxidation is the most applicable incineration technique.

5.3.2.1 Flares. Flaring is an open combustion process in which the oxygen required for combustion is provided by the ambient air around the flame. Good combustion in a flare is governed by flame temperature, residence time of components in the combustion zone, turbulent mixing of the components to complete the oxidation reaction, and oxygen for free radical formation.

There are two types of flares: ground-level flares and elevated flares. Kalcevic presents a detailed discussion of different types of flares, flare design and operating considerations, and a method for estimating capital and operating costs for flares.[34] The basic elements of an elevated flare system are shown in Figure 5-9. Process off-gases are sent to the flare through the collection header (1). The off-gases entering the

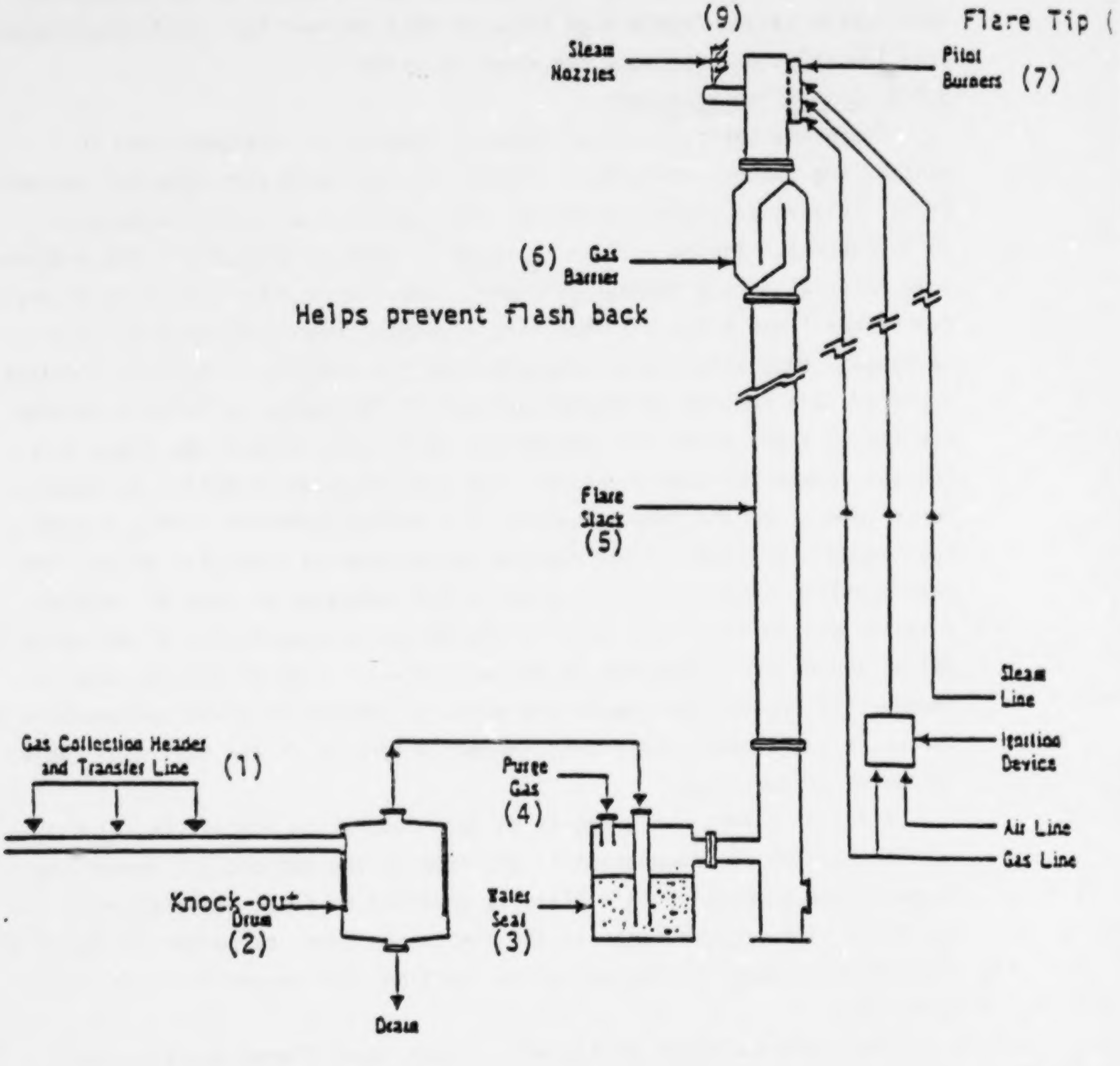

Figure 5-9. Steam-assisted elevated flare system.

header can vary widely in volumetric flow rate, moisture content, organic concentration, and heat value. The knock-out drum (2) removes water or hydrocarbon droplets that could create problems in the flare combustion zone. Off-gases are usually passed through a water seal (3) before going to the flare. This prevents possible flame flashbacks, caused when the off-gas flow to the flare is too low and the flame front pulls down into the stack.

Purge gas ($N_2$, $CO_2$, or natural gas) (4) also helps to prevent flashback in the flare stack (5) caused by low off-gas flow. The total volumetric flow to the flame must be carefully controlled to prevent low flow flashback problems and to avoid a detached flame (a space between the stack and flame with incomplete combustion) caused by an excessively high flow rate. A gas barrier (6) or a stack seal is sometimes used just below the flare head to impede the flow of air into the flare gas network.

The organic vapor stream enters at the base of the flame where it is heated by already burning fuel and pilot burners (7) at the flare tip (8) (see Figure 5-10A). Fuel flows into the combustion zone where the exterior of the microscopic gas pockets is oxidized. The rate of reaction is limited by the mixing of the fuel and oxygen from the air. If the gas pocket has sufficient oxygen and residence time in the flame zone, it can be completely burned. A diffusion flame receives its combustion oxygen by diffusion of air into the flame from the surrounding atmosphere. The high volume of fuel flow in a flare requires more combustion air at a faster rate than simple gas diffusion can supply so flare designers add steam injection nozzles (9) to increase gas turbulence in the flame boundary zones, thus drawing in more combustion air and improving combustion efficiency. This steam injection promotes smokeless flare operation by minimizing the cracking reactions that form carbon. Significant disadvantages of steam usage are the increased noise and cost. The steam requirement depends on the composition of the gas flared, the steam velocity from the injection nozzle, and the tip diameter. Although some gases can be flared smokelessly without any steam, typically 0.15 to 0.5 kg of steam per kg of flare gas is required.

Steam injection is usually controlled manually with the operator observing the flare (either directly or on a television monitor) and adding steam as required to maintain smokeless operation. Several flare manufacturers offer devices that sense a flare's flame characteristics and adjust the steam flow rate automatically to maintain smokeless operation.

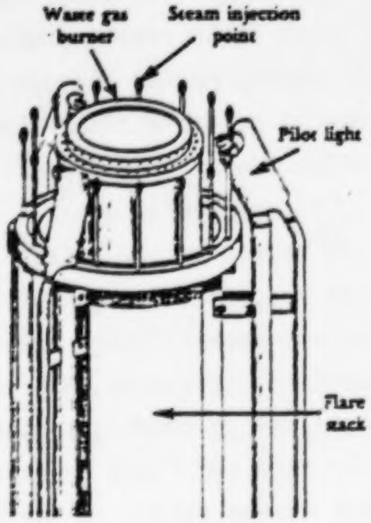

Figure 5-10A. Flare tip.

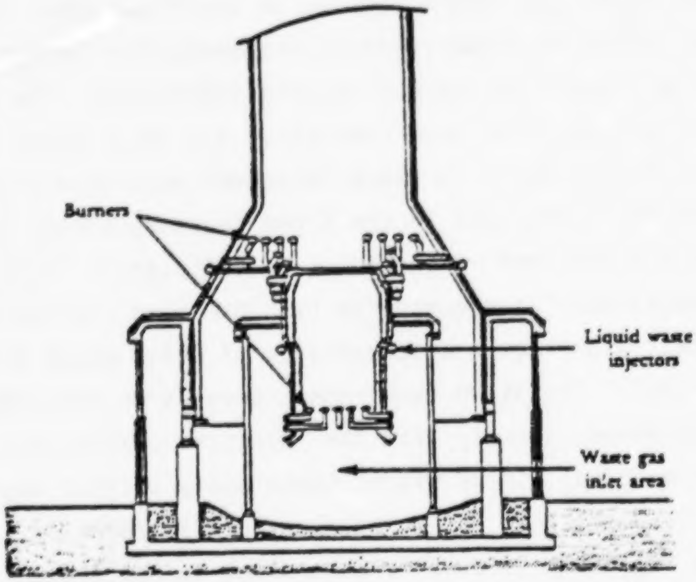

Figure 5-10B. Ground flare.

Some elevated flares use forced air instead of steam to provide the combustion air and the mixing required for smokeless operation. These flares consist of two coaxial flow channels. The combustible gases flow in the center channel, and the combustion air (provided by a fan in the bottom of the flare stack) flows in the annulus. The principal advantage of air-assisted flares is that expensive steam is not required. Air assistance is rarely used on large flares because airflow is difficult to control when the gas flow is intermittent. About 597 W (0.8 hp) of blower capacity is required for each 45 kg/h (100 lb/h) of gas flared.[35]

Ground flares are usually enclosed and have multiple burner heads that are staged to operate based on the quantity of gas released to the flare (see Figure 5-10B). The energy of the gas itself (because of the high nozzle pressure drop) is usually adequate to provide the mixing necessary for smokeless operation, and air or steam assist is not required. A fence or other enclosure reduces noise and light from the flare and provides some wind protection.

Ground flares are less numerous and have less capacity than elevated flares. Typically, they are used to burn gas "continuously," while steam-assisted elevated flares are used to dispose of large amounts of gas released in emergencies.

A series of flare destruction efficiency studies have been performed by EPA. Based on the results of these studies, EPA concluded that 98 percent combustion efficiency can be achieved by steam-assisted and air-assisted flares burning gases with heat contents greater than 11 MJ/m$^3$ (300 Btu/ft$^3$). To achieve this efficiency level, EPA developed a set of flare design guidelines. The guidelines specify flare tip exit velocities for different flare types and waste gas stream heating values.

To ensure that flares achieve the emission reductions required by the standards, Sections 264.1033 and 265.1033 of the rules require the owner/operator to design, monitor, and inspect each flare required to comply with the facility process vent emission rate limits by implementing the following requirements:

- Install, calibrate, maintain, and operate according to the manufacturer's specifications a flow indicator that provides a record of vent stream flow to the control device at least once every hour. The flow indicator sensor shall be installed in the vent stream at the nearest feasible point to the control device inlet, but before being combined with other vent streams.

- Design and operate flares with no visible emissions as determined by the methods specified in Sections 264.1033(e) and 265.1033(e), except for periods not to exceed a total of 5 minutes during any 2 consecutive hours.

- Operate flares with a flame present at all times, as determined by the methods specified in Sections 264.1033(f) and 265.1033(f) in paragraph (f)(2)(iii).

- Use flares only if the net heating value of the gas being combusted is 11.2 MJ/scm (300 Btu/scf) or greater; if the flare is steam-assisted or air-assisted; or if the net heating value of the gas being combusted is 7.45 MJ/scm (200 Btu/scf) or greater if the flare is nonassisted. The net heating value of the gas being combusted shall be determined by the methods specified in Sections 264.1033(e) and 265.1033(e).

- Design and operate steam-assisted and nonassisted flares with an exit velocity, as determined by the methods specified in Sections 264.1033(e) and 265.1033(e), less than 18.3 m/s (60 ft/s), except as provided in Sections 264.1033(d) and 265.1033(d) in paragraphs (d)(4) (ii) and (iii).

- Design and operate steam-assisted and nonassisted flares with an exit velocity, as determined by the methods specified in Sections 264.1033 and 265.1033(e)(3), equal to or greater than 18.3 m/s (60 ft/s) but less than 122 m/s (400 ft/s) if the net heating value of the gas being combusted is greater than 37.3 MJ/scm (1,000 Btu/scf).

- Design and operate steam-assisted and nonassisted flares with an exit velocity, as determined by the methods specified in Sections 264.1033(e)(3) and 265.1033(e)(3), less than the velocity, $V_{max}$, as determined by the method specified in Sections 264.1033(e)(4) and 265.1033(e)(4), and less than 122 m/s (400 ft/s).

- Design and operate air-assisted flares with an exit velocity less than the velocity, $V_{max}$, as determined by the method specified in Sections 264.1033(e)(5) and 265.1033(e)(5).

- Flares used to comply with this section shall be steam-assisted, air-assisted, or nonassisted.

- Use Reference Method 22 in 40 CFR Part 60 to determine the compliance of flares with the visible emission provisions of this subpart. The observation period is 2 hours and shall be used according to Method 22.

- Calculate the net heating value of the gas being combusted in a flare using the following equation:

$$H_T = K \left[ \sum_{i=1}^{n} C_i H_i \right] , \qquad (5\text{-}6)$$

where:

$H_T$ = Net heating value of the sample, MJ/scm; where the net enthalpy per mole of off-gas is based on combustion at 25 °C and 760 mm Hg, but the standard temperature for determining the volume corresponding to one mole is 20 °C;

$K$ = Constant; $1.74 \times 10^{-7}$ (1/ppm) (g mol/scm) (MJ/kcal) where standard temperature for (g mol/scm) is 20 °C;

$C_i$ = Concentration of sample component i in ppm on a wet basis, as measured for organics by Reference Method 18 in 40 CFR Part 60 and measured for hydrogen and carbon monoxide by ASTM D1946-82 (incorporated by reference as specified in Section 260.11); and

$H_i$ = Net heat of combustion of sample component i, kcal/g mole at 25 °C and 760 mm Hg. The heats of combustion may be determined using ASTM D2382-83 (incorporated by reference as specified in Section 260.11) if published values are not available or cannot be calculated.

- Determine the actual exit velocity of a flare by dividing the volumetric flow rate (in units of standard temperature and pressure), as determined by Reference Methods 2, 2A, 2C, or 2D in 40 CFR Part 60 as appropriate; by the unobstructed (free) cross-sectional area of the flare tip.

- Determine the maximum allowed velocity, $V_{max}$, for flares complying with Sections 264.1033(d)(4)(iii) and 265.1033(d)(4)(iii) by the following equation:

$$\text{Log}_{10} (V_{max}) = (H_T + 28.8)/31.7 \quad , \qquad (5\text{-}7)$$

where:

$V_{max}$ = Maximum allowed velocity, m/s

28.8 = Constant

31.7 = Constant

$H_T$ = The net heating value as determined in Sections 264.1033(e)(2) and 265.1033(e)(2).

- Determine the maximum allowed velocity, $V_{max}$, for air-assisted flares by the following equation:

$$V_{max} = 8.706 + 0.7084 (H_T) \quad , \qquad (5\text{-}8)$$

where:

$V_{max}$ = Maximum allowed velocity, m/s

8.706 = Constant

0.7084 = Constant

$H_T$ = The net heating value as determined in Sections 264.1033(e)(2) and 265.1033(e)(2).

5.3.2.2 Thermal Incineration. Any organic chemical heated to a high enough temperature in the presence of enough oxygen will be oxidized to carbon dioxide and water. This is the basic principle of operation of a thermal incinerator. The theoretical temperature required for thermal oxidation to occur depends on the structure of the chemical involved. Some chemicals are oxidized at temperatures much lower than others. The organic destruction efficiency of a thermal oxidizer can be affected by variations in chamber temperature, residence time, inlet organic concentration, compound type, and flow regime (mixing). An efficient thermal incinerator system must provide:

1. A chamber temperature high enough to enable the oxidation reaction to proceed rapidly to completion
2. Enough turbulence to obtain good mixing between the hot combustion products from the burner, combustion air, and organics
3. Sufficient residence time at the chosen temperature for the oxidation reaction to reach completion.

A thermal incinerator is usually a refractory-lined chamber containing a burner at one end. As shown in Figure 5-11, discrete dual fuel burners (1) and inlets for the vent gas (2) and combustion air (3) are arranged in a premixing chamber (4) to mix the hot products from the burners thoroughly with the vent gas airstreams. The mixture of hot reacting gases then passes into the main combustion chamber (5). This section is sized to allow the

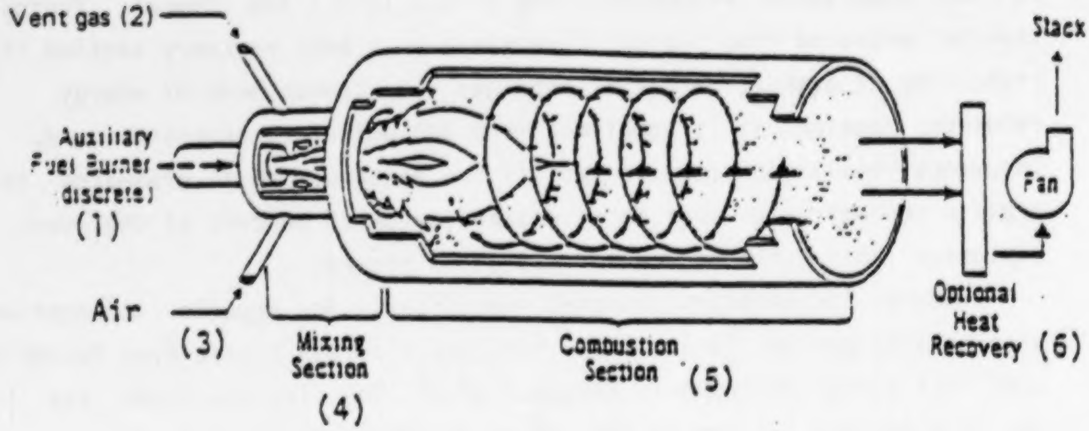

Figure 5-11. Discrete burner, thermal oxidizer.

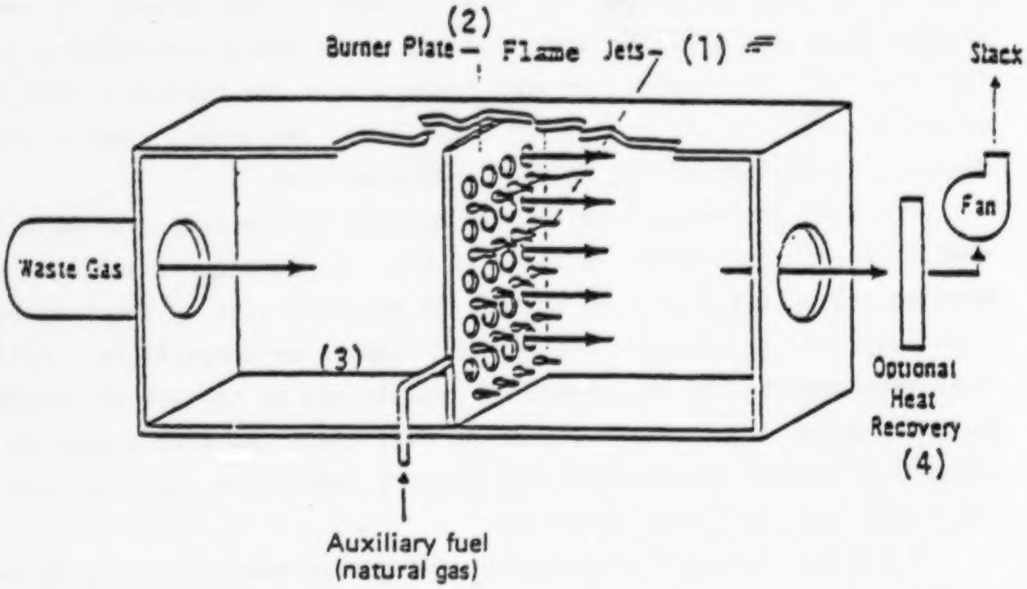

Figure 5-12. Distributed burner, thermal oxidizer.

mixture enough time at the elevated temperature for the oxidation reaction to reach completion (residence times of 0.3 to 1 s are common). Energy can then be recovered from the hot flue gases in a heat recovery section (6). Preheating of combustion air or vent gas is a common mode of energy recovery; however, it is sometimes more economical to generate steam. Insurance regulations require that if the waste stream is preheated, the organic concentration must be maintained below 25 percent of the lower explosive limit (LEL) to prevent explosion hazards.

Thermal incinerators designed specifically for organic incineration with natural gas as the auxiliary fuel may also use a grid-type (distributed) gas burner as shown in Figure 5-12.[36] The tiny gas flame jets (1) on the grid surface (2) ignite the vapors as they pass through the grid. The grid acts as a baffle for mixing the gases entering the chamber (3). This arrangement ensures burning of all vapors at lower chamber temperature and uses less fuel. This system makes possible a shorter reaction chamber yet maintains high efficiency.

Other parameters affecting incinerator performance (i.e., organic vapor destruction efficiency) are the vent gas organic vapor composition, concentration, and heating value; the water content in the stream; the amount of excess combustion air (the amount of air above the stoichiometric air needed for reaction); the combustion zone temperature; the period of time the organics remain in the combustion zone (i.e., "residence time"); and the degree of turbulent mixing in the combustion zone.

The vent gas heating value is a measure of the heat available from the combustion of the organic in the vent gas. Combustion of vent gas with a heating value less than 1.86 MJ/Nm$^3$ (50 Btu/scf) usually requires burning auxiliary fuel to maintain the desired combustion temperature. Auxiliary fuel requirements can be lessened or eliminated by the use of recuperative heat exchangers to preheat combustion air. Vent gas with a heating value above 1.86 mJ/Nm$^3$ (50 Btu/scf) may support combustion, but may need auxiliary fuel for flame stability.

A thermal incinerator handling vent gas streams with varying heating values and moisture content requires careful adjustment to maintain the proper chamber temperatures and operating efficiency. Water requires a great deal of heat to vaporize, so entrained water droplets in a vent gas stream can substantially increase auxiliary fuel requirements because of the additional energy needed to vaporize the water and raise it to the combustion chamber temperature. Combustion devices are always operated with some quantity of excess air to ensure a sufficient supply of oxygen. The amount of excess air used varies with the fuel and burner type, but it should be kept as low as possible. Using too much excess air wastes fuel because the additional air must be heated to the combustion chamber temperature. A large amount of excess air also increases flue gas volume and may increase the size and cost of the system. Packaged, single unit thermal incinerators can be built to control streams with flow rates in the range of 0.1 $Nm^3/s$ (200 scfm) to about 24 $Nm^3/s$ (50,000 scfm).

To ensure that the thermal incinerator is operated and maintained within design specifications, Sections 264.1033(f) and 265.1033(f) require the owner/operator to monitor and inspect each thermal incinerator required to comply with the facility process vent emission rate limits by implementing the following requirements:

- Install, calibrate, maintain, and operate according to the manufacturer's specifications a flow indicator that provides a record of vent stream flow to the control device at least once every hour. The flow indicator sensor shall be installed in the vent stream at the nearest feasible point to the control device inlet, but before being combined with other vent streams.
- Install a temperature monitoring device equipped with a continuous recorder. The device shall have an accuracy of ±1 percent of the temperature being monitored in degrees Celsius or ±0.5 °C, whichever is greater. The temperature sensor shall be installed at a location in the combustion chamber downstream of the combustion zone.

Also, visible emissions from an incinerator indicate incomplete combustion, i.e., inefficient operation.

5.3.2.3 Catalytic Incinerators. A catalyst is a substance that changes the rate of a chemical reaction without being permanently altered. Catalysts in catalytic incinerators cause the oxidizing reaction to occur at a lower temperature than is required for thermal oxidation. Catalyst materials include platinum, platinum alloys, copper oxide, chromium, and cobalt. These materials are plated in thin layers on inert substrates designed to provide maximum surface area between the catalyst and the organic vapor stream.

Figure 5-13 presents a catalytic incinerator. The vent gas (1) is introduced into a mixing chamber (3) where it is heated to approximately 320 °C (~600 °F) by the hot combustion products of the auxiliary burners (2). The heated mixture then passes through the catalyst bed (4). Oxygen and organics diffuse onto the catalyst surface and are adsorbed in the pores of the catalyst. The oxidation reaction takes place at these active sites. Reaction products are desorbed from the active sites and diffuse back into the gas. The combusted gas can then be routed through a waste heat recovery device (5) before exhausting into the atmosphere.

Combustion catalysts usually operate over a temperature range of 320 to 650 °C (600 to 1,200 °F). Lower temperatures can slow down or stop the oxidation reaction. Higher temperatures can shorten the life of the catalyst or evaporate the catalyst from the inert substrate. Vent gas streams with high organic concentrations can result in temperatures high enough to cause catalyst failure. In such cases, dilution air may be required. Accumulations of particulate matter, condensed organics, or polymerized hydrocarbons on the catalyst can block the active sites and reduce efficiency. Catalysts can also be deactivated by compounds containing sulfur, bismuth, phosphorous, arsenic, antimony, mercury, lead, zinc, tin, or halogens. If these compounds deactivate the catalytic unit, organics will pass through unreacted or be partially oxidized to form compounds (aldehydes, ketones, and organic acids) that are highly reactive atmospheric pollutants that can corrode plant equipment.

Catalytic incineration destruction efficiency is dependent on organic composition and concentration, operating temperature, oxygen concentration, catalyst characteristics, and space velocity. Space velocity is commonly defined as the volumetric flow of gas entering the catalyst bed chamber divided by the volume of the catalyst bed. The relationship between space velocity and organic destruction efficiency is strongly influenced by catalyst operating temperature. As space velocity increases, organic destruction efficiency decreases, and as temperature increases, organic destruction efficiency increases. A catalytic unit operating at about 450 °C (840 °F) with a catalyst bed volume of 0.014 to 0.057 $m^3$ (0.5 to 2 $ft^3$) per 0.47 scm/s (1,000 scfm) of vent gas passing through the device can achieve 95 percent organic destruction efficiency.[37] Destruction

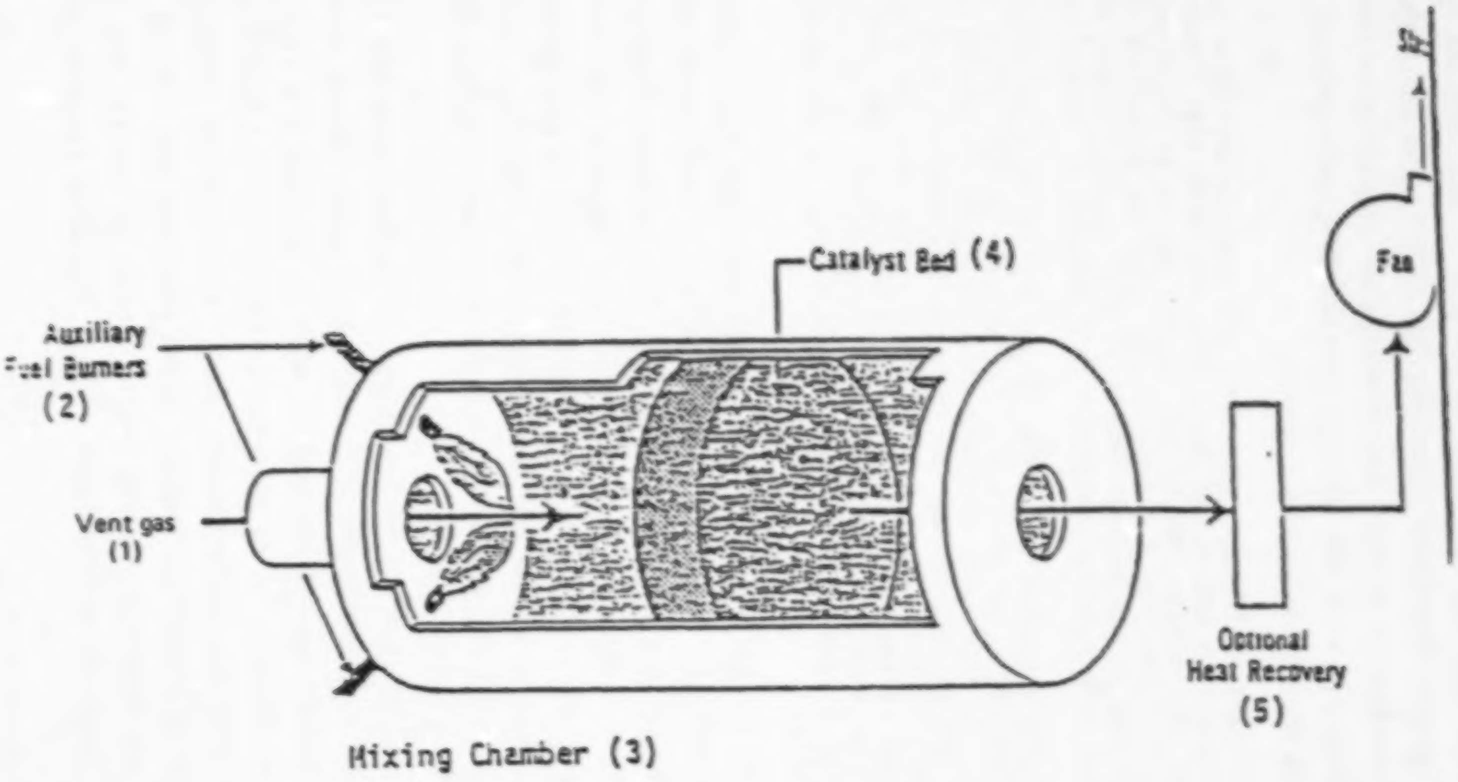

Figure 5-13. Catalytic Incinerator.

efficiencies of 98 percent or greater can be obtained on some streams by utilizing the appropriate catalyst bed volume to vent gas flow rate.

To ensure that the catalytic incinerator is operated and maintained within design specifications, Sections 264.1033(f) and 265.1033(f) require the owner/operator to monitor and inspect each catalytic incinerator required to comply with the facility process vent emission rate limits by implementing the following requirements:

- Install, calibrate, maintain, and operate according to the manufacturer's specifications a flow indicator that provides a record of vent stream flow to the control device at least once every hour. The flow indicator sensor shall be installed in the vent stream at the nearest feasible point to the control device inlet, but before being combined with other vent streams.
- Install a temperature monitoring device equipped with a continuous recorder. The device shall be capable of monitoring temperature at two locations, and have an accuracy of ±1 percent of the temperature being monitored in degrees Celsius or ±0.5 °C, whichever is greater. One temperature sensor shall be installed in the vent stream at the nearest possible point to the catalyst bed inlet, and a second temperature sensor shall be installed in the vent stream at the nearest feasible point to the catalyst bed outlet.

Also, as with thermal incineration, visible emissions from a catalytic incinerator indicate incomplete combustion, i.e., inefficient operation.

5.3.2.4 Boilers or Process Heaters. Fired-process equipment or furnaces make up a category that includes boilers, heaters, and incinerators. Such equipment are employed in most chemical plants to provide heat conveniently, efficiently, and at the temperature level required. Indirect-fired furnaces (boilers and process heaters) are those where heating media are separated from process streams.

Industrial boilers are of two types. Fire-tube units are similar to shell-and-tube heat exchangers with combustion gases flowing through the tubes. The center tube of the bundle, much larger than the rest, comprises the combustion chamber. Flow reverses at the end of the bundle and passes back through numerous smaller outer tubes. Efficient and compact, fire-tube boilers are always shop fabricated. Steam pressures are limited by the strength of the large cylindrical shell. These, of course, are less than could be contained in smaller tubes. Thus, fire-tube furnaces are employed primarily for generating modest amounts of low-pressure saturated steam. Because of geometry, the combustion chamber and flue gas tubes are not compatible with continuous cleaning. This, in addition to a limited combustion residence time, restricts fire-tube boilers to fuels no dirtier or less convenient than residual oil.

Water-tube boilers contain steam within the tubes while combustion occurs in a boxlike open chamber. In large boilers, hundreds to thousands of tubes, usually 7 to 12 cm (2.7 to 4.7 in.) in diameter, are installed side by side, forming the walls of the combustion chamber and of baffles that control flow of and remove heat from combustion gases. In the combustion area, known as the radiant section, gas temperatures drop from about 1,930 °C (3,506 °F) to 1,030 °C (1,886 °F). After combustion products have been thus cooled by radiation to wall tubes, they pass at high velocity through slots between more tubes suspended as large banks in the gas stream. This is known as the convection section. In the radiant section, such direct exposure to higher temperature gases would damage the tube metal. Gas entering the convection section at about 1,030 °C (1,886 °F) leaves near 330 °C (626 °F). Tubes in the radiant section are normally filled with circulating, boiling liquid to avoid hot spots. When superheating is desired, this occurs in the hot end of the convection system.

Because small tubes are capable of much higher pressures than is the large shell of a fire-tube boiler, elevated steam pressures as well as superheat are common in water-tube furnaces. Steam at 45 bar (652.7 psi) pressure superheated to 400 °C (752 °F) is a typical maximum. Saturated process steam is also commonly generated at pressures of 17 and 33 bar (246.6 and 478.6 psi) in water-tube boilers. Pressures lower than this are impractical because of distribution piping costs. If lower pressure process steam is needed in substantial quantity (i.e., greater than 5 kg/s [11.023 lb/s]), it will probably prove practical to generate high-pressure steam at 45 bar (652.7 psi) and 400 °C (752 °F), pass it through an expansion turbine to recover cheap power, and employ the exhaust for process needs. This is known as cogeneration.

Because of the large, open combustion chambers, coal and wood fueling is common in water-tube furnaces. Flyash and soot are cleaned from convection tubes by automatic "soot blowers" that direct high-velocity steam or air jets against outer surfaces of tubes while the boiler is operating. Water-tube boilers can be shop fabricated with heating duties up to 100,000 kJ/s (94,860 Btu/s). Modern units burning coal and wood or residual oil are fitted with dust collectors for flyash removal.

Frequently, the need arises for process heat at temperatures above those available from the systems already described. In these situations and even where an intermediate medium can be used, the process fluid itself is passed through tube coils in a fired furnace. The process system may be reactive, as with pyrolysis furnaces, which have been used extensively to thermally crack hydrocarbons for ethylene and propylene manufacture. The process stream may be nonreactive as well. Such is the case when a fired furnace is used as a reboiler in the distillation of heavy petroleum liquids.

Boilers and process heaters can be designed as control devices to limit organic emissions by incorporating the vent stream (e.g., distillation) with the inlet fuel, or by feeding the stream into the boiler or process heater through a separate burner. These devices are most applicable where high vent stream heat recovery potential exists.

The primary purpose of a boiler is to generate steam. Process heaters are applied within a TSDF for a variety of reasons including preheating and reboiling for some distillation operations. Both devices are important to the operation of a TSDF, and as a result only streams that are certain not to reduce the device's performance or reliability warrant use of a boiler or process heater as a combustion control device. Note: Boilers and process heaters can be used without a RCRA permit only if they burn gases, not hazardous waste liquids (not even hazardous waste liquids coming from an air vent). Variations in vent stream flow rate and/or heating value could affect the heat output or flame stability of a boiler or process heater and should be considered when using these combustion devices. Performance or reliability may be affected by the presence of corrosive products in the vent stream. Because these compounds could corrode boiler or process heater materials, vent streams with a relatively high concentration of halogenated or sulfur-containing compounds are usually not combusted in boilers or process heaters. When corrosive organic compounds are combusted, the flue gas temperature must be maintained above the acid dewpoint to prevent acid deposition and subsequent corrosion from occurring.

The introduction of a distillation vent stream into the furnace of a boiler or heater could alter the heat transfer characteristics of the furnace. Heat transfer characteristics are dependent on the flow rate, heating value, and elemental composition of the distillation vent stream, as well as the size and type of heat generating unit being used. Often, there is no significant alteration of the heat transfer, and the organic content of the distillation stream can, in some cases, lead to a reduction in the amount of fuel required to achieve the desired heat production. In other cases, the change in heat transfer characteristics after introduction of the distillation stream may adversely affect the performance of the heat generating unit and increase fuel requirements. If for a given distillation vent stream increased fuel is required to achieve design heat production to the degree that equipment damage (e.g., tube failure due to local hot spots) might result, then heat-generating units would not be applicable as an organic control device for that vent stream. In addition to these reliability problems, potential safety problems are associated with ducting distillation vents to a boiler or process heater. Variation in the flow rate and organic content of the vent stream could, in some cases, lead to explosive mixtures that could cause extensive damage. Another related problem is flame fluttering that could result from these variations.

When a boiler or process heater is applicable and available, either is an excellent control device because each can provide at least 98 percent destruction of organics. However, to ensure a control efficiency of 98 percent, the waste must be introduced into the flame zone. Temperatures are highest at the flame zone, and combustion kinetics are much more rapid, resulting in high destruction efficiencies. In addition, near complete recovery of the vent stream heat content is possible.

The control efficiency or organic vapor removal efficiency can be determined at any given time as follows:

$$\frac{M_i - M_o}{M_i} = E_R;\ E_R \times 100 = \%\ \text{Removal} \quad , \qquad (5\text{-}9)$$

where:

$M_i$ = Inlet organic mass flow rate, lb/h,

$M_O$ = Outlet organic mass flow rate, lb/h,

$E_R$ = Organic vapor removal/control efficiency.

1. Monitor the concentration of the inlet airstream and the outlet airstream together with the volume flow rate and convert to a mass flow rate.

2. Place the mass flow rate values into the equation for instantaneous removal efficiency (see above).

For an average removal efficiency over a defined time interval t, the concentration of the inlet and outlet airstreams should be monitored over the time interval t and averaged by extrapolation or time integration.

The parameters that affect the efficiency of a thermal incinerator (e.g., boilers and process heaters) are the same parameters that affect the efficiency of these devices when they function as air pollution control devices. These parameters are temperature, residence time, inlet organic concentration, compound type, and flow regime (mixing). Accordingly, to ensure that the boilers or process heaters are maintained within design specifications, Sections 264.1033(f) and 265.1033(f) require the owner/operator to monitor, inspect, and maintain each boiler or process heater required to comply with facility process vent emission rate limits by implementing the following requirements:

- Install, calibrate, maintain, and operate according to the manufacturer's specifications a flow indicator that provides a record of vent stream flow to the control device at least once every hour. The flow indicator sensor shall be installed in the vent stream at the nearest feasible point to the control device inlet, but before being combined with other vent streams.

- For boilers or process heaters having a design heat input capacity less than 44 MW, install a temperature monitoring device equipped with a continuous recorder. The device shall have an accuracy of ±1 percent of the temperature being monitored in degrees Celsius or ±0.5 °C, whichever is greater. The temperature sensor shall be installed at a location in the furnace downstream of the combustion zone.

- For boilers or process heaters having a design heat input capacity greater than or equal to 44 MW, install a monitoring device equipped with a continuous recorder to measure a parameter that demonstrates good combustion operating practices are being used (e.g., concentration of CO, $O_2$, hydrocarbons).

### 5.3.3 Adsorption

Adsorption is a mass-transfer operation involving interaction between gaseous and solid-phase components. The gas-phase (adsorbate) surface is captured on the solid-phase (adsorbent) surface by physical or chemical adsorption mechanisms. Physical adsorption is a mechanism that takes place when intermolecular (van der Waals) forces attract and hold the gas molecules to the solid surface.[38] Chemisorption occurs when a chemical bond forms between the gas- and solid-phase molecules. A physically adsorbed molecule can readily be removed from the adsorbent (under suitable temperature and pressure conditions), while the removal of a chemisorbed component is much more difficult.

The most commonly encountered industrial adsorption systems use activated carbon as the adsorbent. Activated carbon is effective in capturing certain organic vapors by the physical adsorption mechanism. However, activated carbon has a finite adsorption capacity. When the carbon becomes saturated (i.e., all of the carbon surface is covered with organic material), there is no further organic removal; all vapors pass through the carbon bed. At this point (referred to as "breakthrough"), the organic compounds must be removed from the carbon before adsorption can resume. This process is called desorption or regeneration. The organics may be released for recovery by regeneration of the adsorption bed with steam.

Oxygenated adsorbents such as silica gels, diatomaceous earth, alumina, or synthetic zeolites exhibit a greater selectivity than activated carbon for capturing some compounds. These adsorbents have a strong preferential affinity for water vapor over organic gases and would be of little use for the high moisture gas streams from some distillation vents.[39]

The two basic configurations for carbon adsorption systems are regenerative and nonregenerative systems. In regenerative systems, fixed-bed carbon adsorbers are used for controlling continuous, organic gas streams with flow rates ranging from 30 to over 3,000 $m^3$/min (1,000 to over 100,000 $ft^3$/min). The organic concentration can be as low as several parts per billion by volume (ppbv) or as high as 25 percent of the lower explosive limit of the vapor stream constituents. Fixed-bed carbon adsorbers may be operated in either intermittent or continuous modes. For intermittent operation, the adsorber removes organics only during a specific time period.

Intermittent mode of operation allows a single carbon bed to be used because it can be regenerated during the off-line periods. For continuous operation, the unit is equipped with two or more carbon beds so that at least one bed is always available for adsorption while other beds are being regenerated. In nonregenerative systems, the spent carbon is replaced with fresh carbon and is disposed of or reactivated off-site for eventual reuse. Nonregenerative systems (e.g., carbon canisters) are applicable for controlling organic emissions that are expected to vary in types of organics and concentrations and to occur at relatively low total mass rates. Carbon canisters typically consist of a 0.21-$m^3$ (55-gal).drum with inlet and outlet pipe fittings. A typical canister unit is filled with 70 to 90 kg (150 to 200 lb) of activated carbon. Use of carbon canisters is limited to controlling low-volume gas streams with flow rates less than 3 $m^3$/min (100 $ft^3$/min). Carbon cannot be regenerated directly in the canister. Once the activated carbon in the canister becomes saturated by the organic vapors, the carbon canister must be removed and replaced with a fresh carbon canister. The spent carbon canister is then recycled or discarded depending on site-specific factors.

The design of a carbon adsorption system depends on the chemical characteristics of the organic compound being recovered, the physical properties of the vent gas stream (temperature, pressure, and volumetric flow rate), and the physical properties of the adsorbent. The mass flow rate of organic from the gas phase to the surface of the adsorbent (the rate of capture) is directly proportional to the difference in organic concentration between the gas phase and the solid surface. In addition, the mass flow rate of organic is dependent on the adsorbent bed volume, the surface area of adsorbent available to capture organic, and the rate of diffusion of organic through the gas film at the gas- and solid-phase interface. Physical adsorption is an exothermic operation that is most efficient within a narrow range of temperature and pressure. A schematic diagram of a typical fixed-bed, regenerative carbon adsorption system is given in Figure 5-14. The process vent gases are filtered and cooled (1) before entering the carbon bed. The inlet gases to an adsorption unit are filtered to prevent bed contamination. The gases are cooled to maintain the bed at optimum operating temperature and to prevent fires or polymerization of the hydrocarbons. Vapors entering

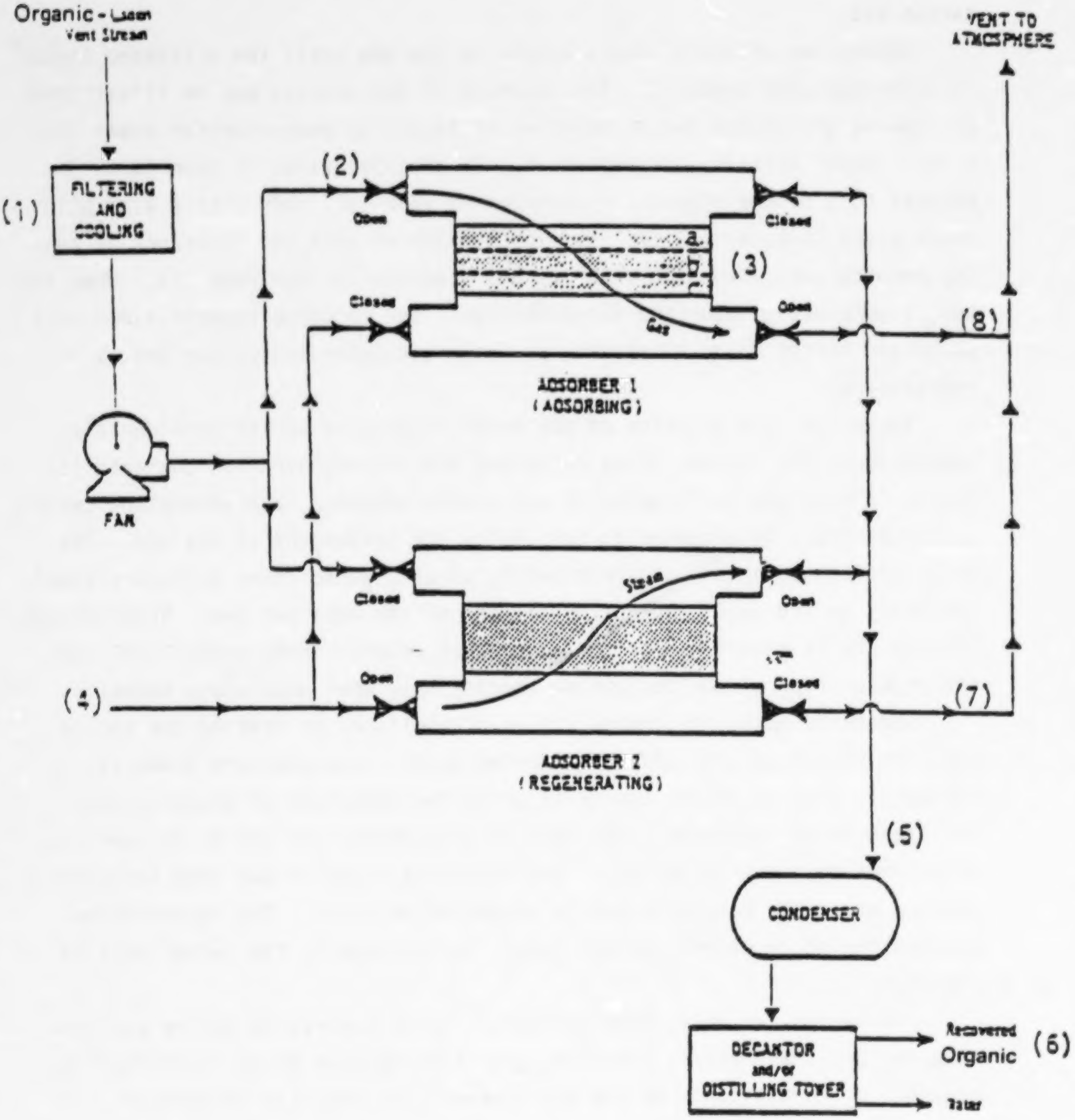

Figure 5-14. Two-stage regenerative adsorption system.

the adsorber stage of the system (2) are passed through the porous activated carbon bed.

Adsorption of inlet vapors occurs in the bed until the activated carbon is saturated with organics. The dynamics of the process may be illustrated by viewing the carbon bed as a series of layers or mass-transfer zones (3a, b, c). Gases entering the bed are highly adsorbed first in zone (a). Because most of the organic is adsorbed in zone (a), very little adsorption takes place in zones (b) and (c). Adsorption in zone (b) increases as zone (a) becomes saturated with organics and proceeds through zone (c). When the bed is completely saturated (breakthrough), the incoming organic-laden vent gases are routed to an alternate bed while the saturated carbon bed is regenerated.

Typically, the duration of the adsorption cycle varies considerably depending on the solvent being reclaimed and its regeneration characteristics. To maximize performance of the carbon adsorber, the adsorption cycle duration should be extended to just below the breakpoint of the bed. The bed's breakthrough can be determined by using organic vapor analyzers simultaneously on the inlet and outlet streams of the adsorber bed. Breakthrough history can be determined on the particular process being controlled, then the regeneration of the bed can be started only when absolutely necessary.

Regeneration of the carbon bed is accomplished by heating the bed or applying vacuum to draw off the adsorbed gases. Low-pressure steam (4) is frequently used as a heat source to strip the adsorbent of organic vapor. The steam-laden vapors are then sent to a condenser (5) and on to some type of solvent recovery system (6). The regenerated bed is put back into active service while the saturated bed is purged of organics. The regeneration process may be repeated numerous times, but eventually the carbon must be replaced.

The system variables that influence carbon adsorption system performance include temperature, pressure, gas velocity, bed depth, humidity, and presence of contaminants in the gas stream. For physical adsorption processes, the capacity of an adsorbent decreases as system temperature increases. Adsorption capacity increases with an increase in the partial pressure of the vapor, which is proportional to the total pressure of the system. Residence time in the bed is a function of gas velocity. Capture efficiency, the percentage of organics removed from the inlet gas stream by the adsorbent, is directly related to residence time. Gas velocity can be determined for a given volume of contaminant gas as a function of the diameter of the adsorber.

Providing a sufficient bed depth is very important in achieving efficient organic removal. If the adsorber bed depth is shorter than the required mass transfer zone (MTZ), breakthrough will occur immediately, thus rendering the system ineffective. The MTZ is a function of six factors: the adsorbent particle size, gas velocity, adsorbate concentration, fluid properties of the gas stream, temperature, and pressure of the system. MTZ can be estimated from experimental data as follows:

$$MTZ = \frac{1}{1 - X_s} D\left(1 - \frac{C_B}{C_s}\right) , \qquad (5\text{-}10)$$

where:

$D$ = Bed depth, m

$C_B$ = Breakthrough capacity, % (may be obtained from carbon suppliers in some cases; usually determined experimentally)

$C_S$ = Saturation capacity, % (may be obtained from the carbon supplier)

$X_S$ = Degree of saturation in the MTZ, % (usually assumed to be 50 percent)

MTZ = Length of MTZ, m.

Actual bed depths are usually many times the MTZ to allow for adequate cycle times.

Activated carbon preferentially adsorbs nonpolar hydrocarbons over polar water vapor. However, at relative humidities over 50 percent, water molecules will begin to compete with the hydrocarbon molecules for adsorption sites. Consequently, the carbon bed working capacity is decreased. Above an organic concentration of 1,000 ppm, high moisture does not significantly affect performance. Thus, obtaining good adsorber performance for gas streams with a high relative humidity (i.e., >50 percent) and low organic concentration (<1,000 ppm) requires preconditioning the gas stream upstream of the carbon bed. This can be accomplished using a dehumidification system, installing duct burners to heat the gas stream, or diluting the gas stream with ambient air. In addition, contaminants such as particulates, entrained liquid droplets, and organic compounds with high boiling points can also reduce adsorber efficiency.

Carbon bed operating temperature can also affect carbon adsorber performance. Excessive bed temperatures can result due to the release of heat from exothermic chemical reactions that may occur in the carbon bed. Ketones and aldehydes are especially reactive compounds that exothermically polymerize in the carbon bed. If temperatures rise too high, spontaneous combustion will result in carbon bed fires. To avoid this problem, carbon adsorbers applied to gas streams containing these types of compounds must be carefully designed and operated to allow sufficient airflow through the bed to remove excess heat.

In determining the control efficiency for a carbon adsorption system, the entire system must be considered. If the carbon adsorption system is nonregenerative, the control efficiency or organic vapor removal efficiency can be determined at any given time as follows:

$$\frac{M_i - M_o}{M_i} = E_R \; ; \; E_R \times 100 = \% \text{ Removal} \quad , \qquad (5\text{-}11)$$

where:

$M_i$ = Inlet organic vapor mass flow rate, lb/h

$M_o$ = Outlet organic vapor mass flow rate, lb/h

$E_R$ = Organic vapor removal/control efficiency.

1. Monitor the inlet airstream and the outlet airstream simultaneously.
2. Place the mass flow rate values into the equation for instantaneous removal efficiency.

For an average removal efficiency over a defined time interval t, the mass flow rate of the inlet and outlet airstreams should be monitored over the time interval t and averaged by extrapolation or time integration. If the carbon adsorption system is regenerative, and regeneration is conducted on-site, the control efficiency can be calculated as follows:

$$\frac{M_i - (M_{o_1} + M_{o_2})}{M_i} = E_R \text{ ; } E_R \times 100 = \% \text{ Removal} \quad , \qquad (5\text{-}12)$$

where:

$M_i$ = Inlet organic vapor mass flow rate, lb/h

$M_{o_1}$ = Outlet organic vapor mass flow rate, lb/h

$M_{o_2}$ = Outlet organic vapor mass flow rate of uncondensed vapor from regeneration, lb/h

$E_R$ = Organic vapor removal/control efficiency.

For gas-phase carbon adsorption applications, a fixed-bed, regenerable carbon adsorption system typically involves two separate steps. The first is the adsorption step where the organic (adsorbate) is adsorbed onto the surface of the activated carbon (adsorbent). The second step is where the adsorbate is removed from the carbon (desorption) and recovered for reuse. Both of these steps are equally important in the overall process, and any organics released to the atmosphere in either step must be accounted for and included in the control device efficiency determination. For example, regeneration or desorption is usually accomplished by passing steam through the bed countercurrent to the vent stream flow. Regeneration can also be accomplished by applying heat to burn the adsorbate. When steam is used in the regeneration process, the steam carries the desorbed organics from the bed and is then condensed and decanted. Any organics that pass through the condenser (i.e., not condensed) and are vented to the atmosphere should be quantified and accounted for in the efficiency determination of the overall carbon adsorption system. Also, if there are organics in the aqueous phase of the steam condensate that go untreated and eventually escape to the atmosphere, these too must be accounted for in the control device efficiency determination. The TSDF owner/operator is expected to ensure that organic emissions resulting from regeneration are also controlled and that condensed organic waste is properly disposed.

Emission source test data for full-sized, fixed-bed carbon adsorbers operating in industrial applications has been compiled by EPA for a study of carbon adsorber performance.[40] The analysis of these data supports the conclusion that for well-designed and operated carbon adsorbers, continuous organic removal efficiencies of at least 95 percent are achievable over long periods. Several units have been shown to continuously achieve organic removal efficiences of 97 to 99 percent. An equivalent level of performance is indicated by results of emission source tests conducted on carbon canisters.

To ensure that the carbon adsorption system is operated and maintained within design specifications, Sections 264.1060(f) and 265.1060(f) require the owner/operator to monitor, inspect, and maintain each carbon adsorption system required to comply with facility process vent emission rate limits by implementing the following requirements:

- Install, calibrate, maintain, and operate according to the manufacturer's specifications a flow indicator that provides a record of vent stream flow to the control device at least once every hour. The flow indicator sensor shall be installed in the vent stream at the nearest feasible point to the control device inlet, but before being combined with other vent streams.

- For carbon adsorption systems that regenerate the carbon bed directly in the control device such as a fixed-bed carbon adsorber, install a monitoring device equipped with a continuous recorder to measure the concentration level of the organic compounds in the exhaust vent stream from the carbon bed; or

- Install a monitoring device equipped with a continuous recorder to measure a parameter that demonstrates the carbon bed is regenerated on a regular, predetermined time cycle.

- For a carbon adsorption system in which the carbon bed is regenerated directly on-site in the control device such as a fixed-bed carbon adsorber, the owner/operator is to replace the existing carbon in the control device with fresh carbon at a regular, predetermined time interval that is no longer than the carbon service life established as a requirement of Section 270.25(e)(3)(vi).

- For a carbon adsorption system in which the carbon bed is not regenerated directly on-site in the control device such as a carbon canister, replace the existing carbon in the control device with fresh carbon on a regular basis by using one of the following procedures:

    - -- Monitor the concentration level of the organic compounds in the exhaust vent stream from the carbon adsorption system on a regular schedule, and replace the existing carbon with fresh carbon immediately when carbon breakthrough is indicated. The monitoring frequency shall be at an interval no greater than 10 percent of the time required to consume the total carbon working capacity established as a requirement of Section 270.24(e)(3)(vii).

-- Replace the existing carbon with fresh carbon at a regular, predetermined time interval that is less than the design service life of the carbon established as a requirement of Section 270.24(d)(3)(vii).

The amount of organic recovered from the regenerated bed as a function of cycle time provides a secondary indicator of system efficiency and must be monitored.

## 5.4 CONTROL DEVICE DESIGN CONSIDERATIONS REQUIRED BY THE REGULATION

Design analysis for air pollution control equipment is performed for a variety of reasons, including (1) to anticipate compliance with applicable air pollution codes, (2) to estimate performance of existing control equipment, (3) to evaluate the feasibility of a proposed equipment design, or (4) to assess the effect of process modification on control equipment performance. Regardless of the reason for conducting the design analysis, air pollution control systems are usually designed to control emissions at a minimum cost with maximum reliability. The basic tradeoffs involve decisions between collection efficiency (the percentage reduction in pollutant concentration between the inlet and outlet of the control device), installation cost, and operating cost.

Air pollution control equipment is often designed specifically for the source on which it is installed. The regulation requires that a design analysis be both conducted and documented through engineering calculations, vendor certification, and/or emission testing (Sections 264.1035(b)(4)). The design analysis must establish values for certain key operating parameters that would be indicative of the control device operating at design efficiency. The regulation then specifies operating limits for these key operating parameters based on the design values established during the design analysis (Sections 264.1035(b)(4)(iii)(A)-(G) and 265.1035(b)(4)(iii)(A)-(G)). The owner/operator must then report when any monitored key parameter exceeds these limits for more than 24 hours (see Chapters 7.0 and 8.0 for details on and a discussion of the monitoring and recordkeeping requirements of the regulation). The key operating parameters that must be established during the design analysis are as follows:

- Thermal Incinerator--The design minimum and average temperature in the combustion zone and the combustion zone residence time.

- Catalytic Incinerator--The design minimum and average temperature across the catalyst bed inlet and outlet.

- Boiler or Process Heater--The design minimum and average flame zone temperatures, the flame zone residence time, the description of method and location where the vent stream is introduced into the flame zone.

- Flare--Operating limits for key operating parameters have already been determined for flares (see Sections 264.1033(d) and 265.1033(d)); therefore, no design analysis is required.

- Condenser--The design outlet organic concentration level, the design average temperature of the condenser exhaust vent stream, the design average temperature of the coolant fluid at the condenser inlet and outlet.

- Carbon Adsorption System (Regenerative)--Design exhaust vent stream organic compound concentration level, the number and capacity of carbon beds, the type and capacity of carbon beds, the type and working capacity of activated carbon beds, design total steam flow over the period of each complete carbon bed regeneration cycle, the duration of the carbon bed steaming and cooling/drying cycles, the design carbon bed temperature after regeneration, the design carbon bed regeneration time, and the design service life of carbon.

- Carbon Adsorption System (Nonregenerative)--The design outlet organic concentration level, the capacity of carbon bed, the type and working capacity of activated carbon, and the design carbon replacement interval based on the total carbon working capacity of the control device and source operating schedule.

Other operating parameters are required by the regulation to be considered during the design analysis. However, the regulation does not require design values for these parameters to be established. These operating parameters are the same for all the control devices and are as follows: vent stream composition, constituent concentrations, and flow rate. The condenser and carbon adsorber both have two additional parameters, relative humidity and temperature, that also must be considered in the design analysis. Appendix F provides design checklists of all required operating parameters for carbon adsorption, condensers, combustion devices, and flares.

Numerous procedures are used to design air pollution control systems. These procedures range in difficulty from shortcut "rules of thumb" to in-depth design procedures based on pilot plant data. The "rules of thumb" in the following paragraphs can be applied when reviewing combustion and noncombustion control device designs and can be used to "red flag" parameters that appear out of the ordinary.

### 5.4.1 Heat Exchanger Rules of Thumb[41-43]

1. Corrosive fluids are usually passed on the tube side.

2. High-pressure fluids usually pass on the tube side. Plate exchangers are not recommended for a pressure above 10 bar.

3. Fouling or scaling fluids are placed on the tube side of fixed-tube exchangers. If deposits can be removed by high-velocity steam or water jets, fouling fluids may also pass on the shell side of exchangers that can be exposed for cleaning.

4. High-viscosity fluids are usually placed in the shell side of conventional shell-and-tube exchangers. Plate exchangers are attractive for such service. For viscosities greater than 1 Pa • s, scraped-wall exchangers are attractive.

5. Condensing vapors are usually placed on the shell side.

6. Determine exchanger duty from an energy balance on one side. Allow up to 10 percent losses depending on shell-side temperature.

7. Approach ΔT's (mean temperature difference) are approximately 10 °C (18 °F) for liquids or systems with high heat transfer coefficients.

8. Approach ΔT's (mean temperature difference) are approximately 50 °C (90 °F) for gases or systems with low heat transfer coefficients.

9. Pressure drops are approximately 0.2 to 0.6 bar for liquid heating, cooling, or boiling. For condensation or heat transfer to or from gases, pressure drops are approximately 0.1 bar.

10. The EPA has published guidelines that provide condenser outlet gas temperatures that should not be exceeded when condensing organics with certain vapor pressures (see Table 5-3). These guidelines are useful as an indicator of condenser performance but it must be noted that the guidelines do not account for the molecular weight or initial concentration of the organic to be condensed, each of which has great bearing on how much organic is condensed. For example, if the organic concentration is higher than the saturation concentration at the condensing temperature, condensation is

TABLE 5-3. RECOMMENDED OUTLET GAS TEMPERATURES

1. -25 °C when condensing VOC of vapor pressure >40 kPa (5.8 psia)[a]
2. -15 °C when condensing VOC of vapor pressure >20 kPa (2.9 psia)
3. 0 °C when condensing VOC of vapor pressure >10 kPa (1.5 psia)
4. 10 °C when condensing VOC of vapor pressure >7 kPa (1.0 psia)
5. 25 °C when condensing VOC of vapor pressure >3.5 kPa (0.5 psia)

[a] Vapor pressures as measured at 20 °C.

Source: U.S. Environmental Protection Agency. *Control of Volatile Organic Emissions from Manufacture of Synthesized Pharmaceutical Products*. OAQPS Guideline Series. Publication No. EPA-450/2-78-029. December 1978. p. 1-5.

expected to occur; however, if the initial concentration is below the saturation concentration, little or no condensation is expected.

### 5.4.2 Adsorption Rules of Thumb

1. Adsorber temperatures are usually kept below 55 °C (130 °F); inlet gas temperature should not exceed about 37.7 °C (100 °F) for sustained operations.

2. Some adsorbents will remove water vapor molecules as well as molecules of the contaminated gas. Carbon systems should be operated at relative humidities of 50 percent or less.

3. All particulate matter larger than about 5 $\mu$m in size should be removed before the gas enters the adsorber in a regenerable system.

4. Solvents should have a boiling point less than 260 °C (500 °F) so that they may be readily stripped from the adsorbent by the low-pressure steam.

5. To achieve 90 percent or greater capture efficiency, most carbon adsorption systems are designed for a maximum airflow velocity of 30 m/min (100 ft/min) through the adsorber. A lower limit of at least 6 m/min (20 ft/min) is maintained to avoid flow distribution problems such as channeling.

6. Pressure drops in fixed carbon beds normally range from 750 to 3,730 Pa (3 to 15 in. $H_2O$) depending on the gas velocity, bed depth, and carbon particle size.

7. The optimum steam requirement for thermal swing regeneration usually ranges from 0.25 to 0.35 kg of steam/kg (0.55 to 0.77 lb of steam/lb) of carbon. Steam in these systems is usually supplied at pressures ranging from 21 to 103 kPa (3 to 15 psig).

8. Maximum bed depth for a fixed horizontal bed is recommended as 1.2 m (4 ft). The maximum adsorbent depth of 1.2 m (4 ft) is based on pressure drop considerations.

9. Horizontal flow adsorbers are used for larger flow rates. Adsorbers of this type are manufactured as a package system capable of handling flow rates up to 1,150 $m^3/s$ (40,000 cfm).

### 5.4.3 Combustion Device Rules of Thumb

1. Thermal incinerators generally operate at 700 to 820 °C (1,300 to 1,500 °F) with residence times of approximately 0.1 to 0.6 s. Test results and combustion kinetics analyses indicated that thermal vapor incineration destroys at least 98 percent of nonhalogenated organic compounds in the vapor stream at a temperature of 870 °C (1,600 °F) and a residence time of 0.75 seconds.[44] If the vapor stream contains halogenated compounds, a temperature of 1,100 °C (2,000 °F) and a residence time of 1 second is needed to achieve a 98-percent destruction efficiency.[45]

2. Catalytic incinerators generally operate at 370 to 480 °C (700 to 900 °F) with residence times of a few hundreths of a second.

3. Process boilers are normally designed to operate in excess of 980 °C (1,800 °F) with a flue gas residence time of 0.5 to 3.0 s.

4. Pressure drops in catalytic incinerators normally range from 62 to 125 Pa (0.25 to 0.5 in. $H_2O$).

5. Typical gas velocities for catalytic incinerators range from 20 to 200 feet per second (fps) (6 to 60 m/s).

6. Incinerator warmup usually begins with an outlet temperature of 93.3 °C (200 °F). This temperature is then held for 1 h. Thereafter, the outlet temperature is increased at the rate of 93.3 °C (200 °F) per hour until an outlet temperature of 315.5 °C (600 °F) is reached. Then the outlet temperature may be increased at the rate of 93.3 to 204.4 °C (200 to 400 °F) per hour until the final operating temperature is reached.

7. Typical maximum flare capacity is as follows: ground flare, 80 to 100 thousand lb/h; and elevated flare, 1,000 to 2,000 thousand lb/h.

## 5.5 ADDITIONAL CONTROLS FOR PROCESS VENTS

Permit writers, through the omnibus permitting authority of Section 270.32, are allowed to require emission controls that are more stringent than those specified by a standard on a case-by-case basis. This authority could be used in situations where the permit writer deems there is an unacceptably high risk after application of controls required by an emission standard.

Guidance to help permit writers identify facilities that would potentially have high residual risk due to air emissions is being prepared by EPA. This section provides a general discussion of the controls available for process vents (i.e., condensers, carbon adsorbers, flares, incinerators, boilers, and process heaters) that would result in control levels more stringent than the level achieved under the requirements of Subpart AA of Parts 264 and 265.

### 5.5.1 Condensers

Control devices involving vapor recovery (e.g., condensers) must be designed and operated to recover the organic vapors vented to them with an efficiency of 95 percent in order to satisfy the requirements of Subpart AA of the standards unless the total organic emission limits of Sections 264.1032(a)(1) and 265.1032(a)(1) for all affected process vents can be attained at efficiencies less than 95 percent. The regulation requires that the design outlet organic concentration level, the design average temperature of the condenser exhaust vent stream, and the design average temperature of the coolant fluid at the condenser inlet and outlet be established in addition to the vent stream flow rate and coolant and exhaust vent temperature or concentration of organics in the exhaust vent being monitored. This is to ensure that the condenser is operated and maintained within design specifications and is therefore achieving an efficiency of 95 percent.

Additional control greater than the 95 percent required by the regulation can also be achieved in some situations. Condenser efficiency is dependent on both the concentration and volatility of organics present in the vent stream. Compounds having lower volatilities tend to condense more readily than those of higher volatility. As a result, higher efficiencies are obtainable with vent gas streams containing the less volatile organic compounds. The efficiency of a condenser is directly related to the concentration of the inlet vent gas stream. In general, as the concentration increases, the efficiency of the condenser also increases. Conversely, low concentrations also result in low efficiencies. (See Appendix E for an analysis of the effect of concentration on efficiency.) Therefore, any additional control beyond that set forth by the standard to achieve 95 percent control efficiency must be determined on a case-by-case basis only and will depend on the vent gas organic concentration and volatility of the constituents in the vent stream.

### 5.5.2 Flares

Flaring, unlike heaters, boilers, and incinerators in which combustion takes place in an enclosed chamber, is an open combustion process. For this reason, it is very difficult and economically impracticable to measure emissions from a flare. A standard of performance is therefore not feasible for a flare. Subpart AA of the standard, however, does require that certain conditions be met for process vent streams using flares in order to achieve an efficiency of 95 percent or greater. These conditions are stated in Sections 264.1033 and 265.1033 of the regulation. Because these conditions were generated from test data that show flares meeting certain conditions achieve 98 percent emission reduction, it is very likely that an owner or operator who operates a flare to meet the conditions of Section 264.1033 and 265.1033 will achieve 98 percent destruction efficiency. It should be noted, however, that the conditions established from available test data are the only conditions for which EPA has data supporting that flares achieve 98 percent emission reduction.

### 5.5.3 Thermal Incineration

The process vent rules require that a design analysis be conducted on control devices (i.e., thermal and catalytic incinerators) to establish key operating parameters indicative of a control efficiency of 95 percent or greater. In the case of a thermal incinerator, the key operating parameters that must be established are the design minimum and average temperature in the combustion zone and the combustion zone residence time. The regulation also requires that the vent stream flow rate as well as the temperature downstream of the combustion zone be monitored to ensure that the thermal incinerator is being operated within design specifications and therefore achieving a destruction efficiency of 95 percent or greater (see Sections 264.1033 and 265.1033 as well as Sections 264.1035 and 265.1035, respectively, for monitoring requirements and key operating parameters for catalytic incinerators). The level of control required by the standards does not result in the highest level of emission control that could be achieved by thermal incinerators. For example, all new incinerators can achieve at least 98 weight percent reduction in total organics (minus methane and ethane), provided that the total organic concentration (minus methane and ethane) of the process vent stream being incinerated is greater than approximately 2,000 ppmv (volume, by compound). However, the inlet stream composition greatly affects the maximum achievable destruction efficiency. Much slower combustion reaction rates occur at lower inlet concentrations; therefore, the maximum achievable destruction efficiency decreases as inlet concentration decreases. In summary, additional control greater than the 95 percent required by the regulation can be accomplished by thermal incinerators through proper design, but the inlet organic concentration of the thermal incinerator feed steam must be maintained at greater than 2,000 ppmv.

### 5.5.4 Boilers and Heaters

In the case of boilers and process heaters, the regulation requires that a 95-percent organic reduction be achieved. In addition, the regulation requires that this reduction be validated by establishing key operating parameters in the design of the boiler or process heater and by monitoring certain parameters to ensure the design specification is being maintained. These key operating parameters are the design and average flame zone temperatures, the flame zone residence time, and the description of method and location where the vent stream is introduced into the flame zone. The parameters that are required to be monitored are the vent stream flow rate into the control device and the temperature downstream of the combustion zone (if the design heat input capacity is less than 44 MW) or a parameter that demonstrates good combustion operating practices are being used (if the design heat input capacity is greater than 44 MW). Once these design operating parameters have been established and the specified operating parameters have been monitored, emission reductions of 95 percent, as required by the standard, can be expected for the boiler or process heater. However, greater control than that required by the regulation can be obtained.

Boilers and process heaters can achieve a 98 weight percent reduction, provided that the waste stream is introduced into the flame zone where temperatures are highest. Because higher temperatures are present in the flame zone, more rapid combustion kinetics also occurs in the flame zone. As a result, higher destruction efficiencies are attainable. In fact, greater than 98 percent destruction efficiencies have been demonstrated in tests of the combustion of organic compounds burned as fuels in boilers and process heaters. Additional control greater than the 95 percent required by the regulation can be accomplished, but the vent stream must be introduced into the flame zone.

### 5.5.5 Carbon Adsorption

Subpart AA of the regulation requires that carbon adsorbers achieve a control efficiency of 95 percent unless the total organic emission limits of Sections 264.1032(a)(1) and 265.1032(a)(1) for all affected process vents can be attained at efficiencies less than 95 percent. Subpart AA also requires that this performance standard be demonstrated by conducting a design analysis in which values are established for key operating parameters that would be indicative of the carbon adsorber operating at the design efficiency. For regenerative carbon adsorption systems, the key operating parameters are design exhaust vent stream organic compound concentration level, the number and capacity of carbon beds, the type and capacity of carbon beds, the type and working capacity of activated carbon beds, design total steam flow over the period of each complete carbon bed regeneration cycle, the duration of the carbon bed steaming and cooling/drying cycles, the design carbon bed temperature after regeneration, the design carbon bed regeneration time, and the design service life of carbon. For nonregenerative carbon adsorption systems, the key operating parameters are the design outlet organic concentration level, the capacity of carbon bed, the type and working capacity of activated carbon, and the design carbon replacement interval based on the total carbon working capacity of the control device and source operating schedule.

To ensure that the carbon adsorption system is operated and maintained within these design specifications, the regulation also requires the monitoring of the vent stream flow rate, the concentration of organics in the exhaust vent, and a parameter that demonstrates that the bed is regenerated on a regular basis (for automatic regeneration) or that the bed is replaced on a regular basis. After the design analysis has been conducted and the carbon adsorber has satisfied the monitoring requirements, emission reductions of 95 percent can be expected. As for additional control using carbon adsorbers, the current evaluation of this control technique indicates that 95 percent is the best short- and long-term efficiency that can be expected on an industrywide basis. Therefore, no recommendation for higher efficiencies can be made. That is not to say, however, that higher efficiencies are unobtainable in certain circumstances at individual facilities.

## 5.6 REFERENCES

1. Perry, R. H. (ed.). Chemical Engineers' Handbook. 5th ed. New York, McGraw-Hill Book Co., 1973. p. 13-50 through 13-55.

2. Exner, J. H. Detoxification of Hazardous Waste. Ann Arbor, MI, Ann Arbor Science, 1980. p. 3-25.

3. Metcalf and Eddy, Inc. Briefing: Technologies Applicable to Hazardous Waste. Prepared for U.S. Environmental Protection Agency. Cincinnati, OH. May 1985. Section 2.9.

4. Allen, C. C., et al. (Research Triangle Institute). Field Evaluations of Hazardous Waste Pretreatment as an Air Pollution Control Technique. Prepared for U.S. EPA/ORD/HWERL. Cincinnati, OH. Contract No. 68-03-3253. March 31, 1987. p. 23.

5. Luwa Corporation. Product Literature--Luwa Thin-Film Evaporation Technology. P.O. Box 16348, Charlotte, NC 28216.

6. U.S. EPA/ORD/IERL. Process Design Manual for Stripping of Organics. Cincinnati, OH. Publication No. EPA-600/2-84-139. August 1984.

7. Schweitzer, P. A. Handbook of Separation Techniques for Chemical Engineers. New York, McGraw-Hill Book Co., 1979. p. 1-147 through 1-178.

8. Reference 1, p. 13-1 through 13-60.

9. King, C. J. Separation Processes. New York, McGraw-Hill Book Co., 1971. 809 p.

10. Treybal, R. E. Mass-Transfer Operations. New York, McGraw-Hill Book Co., 1968. p. 220-406.

11. Berkowitz, J. B., et al. Unit Operations for Treatment of Hazardous Industrial Wastes. Noyes Data Corporation. Park Ridge, NJ. 1978. p. 369-405, 849-896.

12. U.S. EPA/ORD/HWERL. Preliminary Assessment of Hazardous Waste Pretreatment as an Air Pollution Control Technique. Publication No. EPA 600/2-86-028, NTIS PB46-17209/A6. March 1986.

13. Reference 2, p. 1-39.

14. Reference 3, Sections 2.9, 2.15, 2.16.

15. Reference 12, p. 45.

16. Reference 12, p. 43.

17. Reference 4, p. 63.

18. Reference 6.

19. Hwang, S. T., and P. Fahrenthold. Treatability of Organic Priority Polluants by Steam Stripping. In: AIChE.

20. ICF Consulting Associates, Incorporated. Guide to Solvent Waste Reduction Alternatives. 707 Wilshire Blvd., Los Angeles, CA 90017. October 10, 1986. p. 5-27, 5-28.

21. Reference 3, Section 2.17.

22. Reference 14, Section 2.16.

23. Reference 11, Section 2.16.

24. Reference 14, p. 869.

25. U.S. EPA/Control Technology Center. Air Stripping of Contaminated Water Sources—Air Emissions and Controls. Research Triangle Park, NC. Publication No. EPA-450/3-87-017. August 1987. 125 p.

26. Reference 11, Section 2.16.

27. Reference 11, p. 869-880.

28. Code of Federal Regulations, Vol. 45, No. 9, Appendix A, January 1980.

29. Erikson, D. G. (Hydroscience). Emission Control Options for the Synthetic Organic Chemical Industry; Control Device Evaluation; Condensation. Prepared for U.S. Environmental Protection Agency. Research Triangle Park, NC. EPA Contract No. 68-02-2577. July 1980. p. II-1.

30. U.S. Environmental Protection Agency. Office of Air and Waste Management. Control Techniques for Volatile Organic Emissions from Stationary Sources. Research Triangle Park, NC. Publication No. EPA-450/2-78-022. May 1978. p. 83.

31. Reference 29, p. IV-1.

32. Reference 29, p. II-3, III-3.

33. Reference 1, p. 10-13 through 10-25.

34. Kalcevic, V. (IT Enviroscience). Control Device Evaluation--Flares and the Use of Emissions as Fuels. In: Organic Chemical Manufacturing. Volume 4: Combustion Control Device. U.S. Environmental Protection Agency. Publication No. EPA-450/3-80-026. December 1980. Report 4.

35. Klett, M. G., and J.B. Galeski (Lockheed Missiles and Space Co., Inc.). Flare System Study. Prepared for U.S. Environmental Protection Agency. Huntsville, AL. Publication No. EPA-600/2-76-079.

36. Reed, R. J. North American Combustion Handbook. Cleveland, North American Manufacturing Company, 1979. p. 269.

37. Key, J. A. (Hydroscience). Emissions Control Options for the Synthetic Organic Chemicals Manufacturing Industry; Control Device Evaluation: Thermal Oxidation. Prepared for U.S. Environmental Protection Agency. Research Triangle Park, NC. EPA Contract No. 68-02-2577.

38. Reference 30, p. 53.

39. Stern, A. C. Air Pollution. Volume IV. 3rd ed. New York, Academic Press, 1977. p. 336.

40. Radian Corporation. Carbon Adsorption for Control of VOC Emissions: Theory and Full Scale System Performance. Draft. Prepared for Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency. EPA Contract No. 68-02-4378/20. June 6, 1988.

41. Ulrich, G. D. A Guide to Chemical Engineering Process Design and Economics. New York, John Wiley & Sons, 1984. p. 426-438.

42. U.S. Environmental Protection Agency. APTI Course 415 Control of Gaseous Emissions Student Manual. Publication No. EPA 450/2-81-005. Research Triangle Park, NC, December 1981.

43. Young, R. A., and F. L. Cross. Specifying Air Pollution Control Equipment. New York, Marcel Dekker, Inc., 1982. p. 123-185.

44. U.S. Environmental Protection Agency. Control Techniques for Volatile Organic Emissions from Stationary Sources. 3rd Edition. Draft Report. Office of Air Quality Planning and Standards. March 1986. pp. 3-1 - 3-83.

45. Reference 44.

# 6.0 TESTING AND EVALUATION

The testing and evaluation of the TSDF facility for process vents and equipment starts with an evaluation of the applicability of the regulation to the sources. (See Chapter 3.0, Section 3.1, Figure 3-1, for a discussion of applicability.) For affected process vents to require emission control under the regulation, emissions from all affected process vents at the facility must either be greater than or equal to 1.4 kg/h (3 lb/h) or greater than or equal to 2.8 Mg/yr (3.1 tons/yr). The specific criterion for a leaking equipment component will depend on the organic content of the waste material handled, the vapor pressure of the waste stream, and whether the waste is a fluid (i.e., liquid or gas) at normal operating conditions. Also, the control requirements for these streams will vary with the type of source (i.e., valve, pump, compressor, flange, etc.) and the properties of the material being handled (i.e., gas/vapor, light-liquid, and heavy-liquid). Figure 6-1 illustrates the decisions and determinations that will be made in addressing the applicability of the regulation to a process vent or equipment component.

For sources covered under the regulation, a monitoring program is required to determine compliance with the regulation. For process vents this will include routine monitoring of control device operating parameters. For equipment, an LDAR program or specific equipment controls will be required. The control equipment required under the rules of Subpart BB may also require routine monitoring to ensure proper performance under specific circumstances.

The following sections discuss allowable sampling and analytical procedures that may be used to determine the above-mentioned applicability. Guidance is given on the most appropriate measurement techniques and the expected accuracy of the various measurement methods.

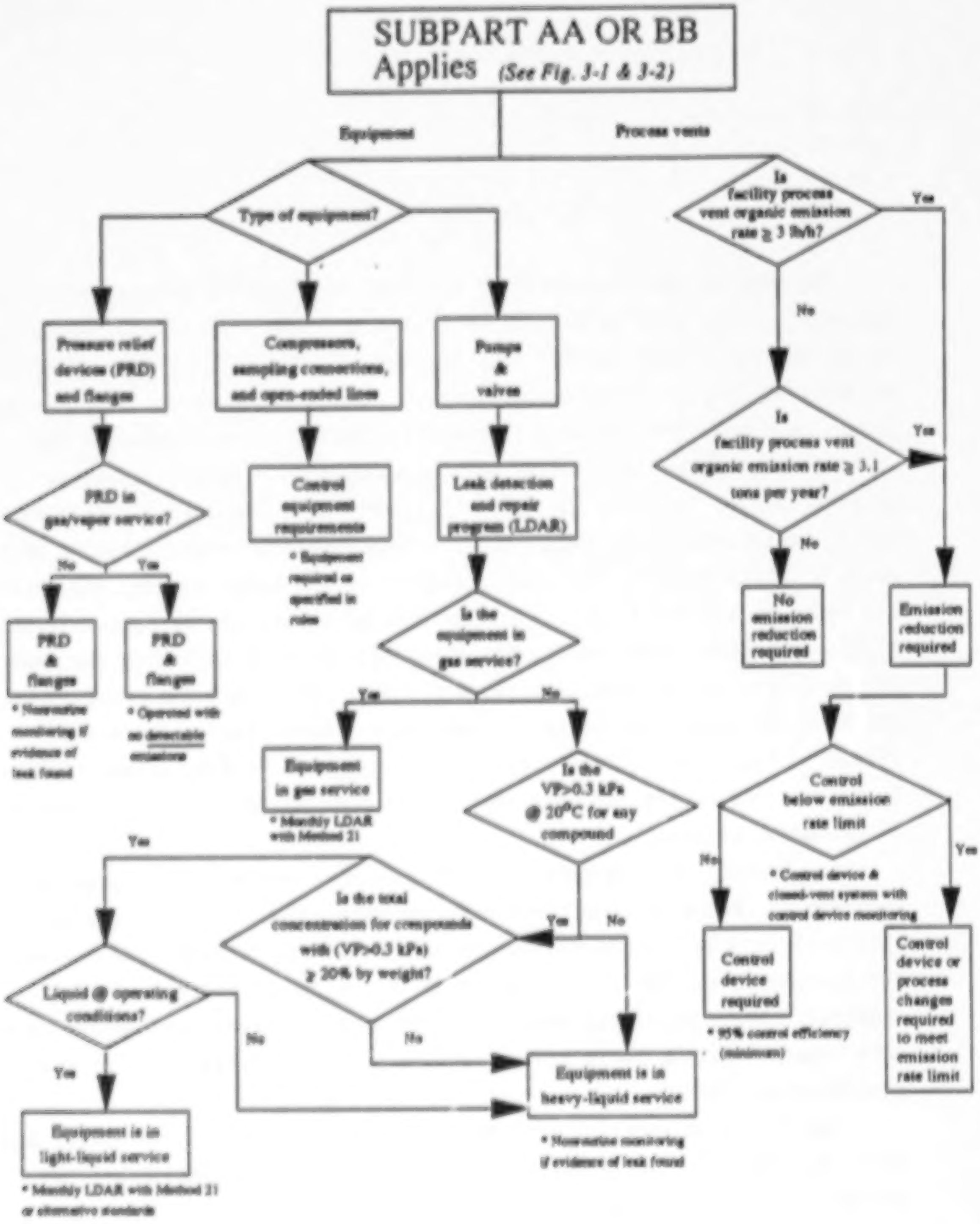
SUBPART AA OR BB Applies (See Fig. 3-1 & 3-2)
Equipment
Process vents
Type of equipment?
Pressure relief devices (PRD) and flanges
Compressors, sampling connections, and open-ended lines
Pumps & valves
PRD in gas/vapor service?
No
Yes
PRD & flanges
* Nonroutine monitoring if evidence of leak found
PRD & flanges
* Operated with no detectable emissions
Control equipment requirements
* Equipment required as specified in rules
Leak detection and repair program (LDAR)
Is the equipment in gas service?
Yes
No
Equipment in gas service
* Monthly LDAR with Method 21
Is the VP>0.3 kPa @ 20°C for any compound
Yes
No
Is the total concentration for compounds with (VP>0.3 kPa) ≥ 20% by weight?
Yes
No
Liquid @ operating conditions?
Yes
No
Equipment is in light-liquid service
* Monthly LDAR with Method 21 or alternative standards
Equipment is in heavy-liquid service
* Nonroutine monitoring if evidence of leak found
Is facility process vent organic emission rate ≥ 3 lb/h?
Yes
No
Is facility process vent organic emission rate ≥ 3.1 tons per year?
Yes
No
No emission reduction required
Emission reduction required
Control below emission rate limit
No
Yes
* Control device & closed-vent system with control device monitoring
Control device required
* 95% control efficiency (minimum)
Control device or process changes required to meet emission rate limit

Figure 6-1. Regulatory decision tree.

## 6.1 EQUIPMENT LEAKS

The equipment leak standards, as defined in the regulation, apply to any "leak" from a piece of piping or process equipment that results in the release of organic emissions. The standards specifically apply to equipment such as valves, pumps, open-ended lines, sampling connections, flanges, etc., that handle material that has an organic content equal to or greater than 10 percent (by weight). If the organic content fluctuates or the equipment handles more than one waste stream, determination will be based on the maximum total organics content of a waste stream contained or contacted by the equipment. Therefore, one of the first steps in determining applicability of the equipment leak standard is to identify whether the hazardous waste stream(s) contacting or contained by the equipment has (or is expected to have) an organic content equal to or greater than 10 percent (by weight). The owner or operator is responsible for making this determination for each piece of equipment that contains or contacts a hazardous waste. This determination may be based on knowledge of the hazardous waste stream or the process by which it was produced (engineering judgment), or it may be based on the results of sampling and analysis of the subject waste stream.

If engineering judgment is used as a basis for determining that the total organic content of a waste stream is less than 10 percent (and thus the equipment is exempt from the requirements of the regulation), then the burden of proof is on the owner or operator. An owner or operator should anticipate that waste stream organic concentration calculations based on engineering judgment (without sampling and analysis) will require support documentation, and such documentation should be furnished along with the permit application and maintained in the operating record. Little or no justification is required when an owner or operator uses engineering judgment to determine that the total organic content of a waste is greater than or equal to 10 percent by weight (and thus subjects the equipment to the requirements of the regulation).

In some situations, it will be relatively easy to demonstrate (without sampling and analysis) that the concentration of total organics in a waste stream is less than 10 percent. For example, the wastewater from a metal plating shop may contain only trace quantities of organics. A process flow diagram along with a list of the feedstocks could be presented to support the conclusion that the total organic concentration in the waste will never approach 10 percent.

Operators of some facilities, such as solvent recycling plants, will likely use engineering judgment to determine that most of their waste streams contain more than 10 percent total organics. Such facilities may, however, have one or more waste streams that contain less than 10 percent total organics. For example, a solvent recycling facility may remove water from waste solvents as a step in the recycling process. It is likely that some of the equipment involved in this process may handle a waste stream that is primarily water. In this case, sampling and analysis of the waste stream as described in Sections 264.1063 and 265.1063 would be the most straightforward way of determining if this portion of the facility would be subject to the requirements of the equipment leak standards. If no sampling and analysis is performed, then process information in the form of process flow diagrams, material balances, and process design specifications would be required to demonstrate that the organic concentration in the waste stream never exceeds 10 percent by weight.

The following subsections discuss sampling and analysis procedures that may be used to determine the organic content of liquid and gaseous waste streams.

### 6.1.1 Liquid Waste Streams

Obtaining a representative sample of a liquid waste is critical in measuring the stream's organic content. Liquid waste streams should be sampled to minimize the loss of volatile organics from the sample. In addition, when the waste is stratified, it is necessary to obtain and integrate subsamples from all layers of the waste material.

The location where the waste total organic content is determined (i.e., where the sample is taken) can greatly affect the results of the determination. This occurs because the concentration level can decrease significantly after generation as the waste is transferred to various waste management units.

If the waste is directly or indirectly exposed to ambient air at any point, a portion of the organics in the waste will be emitted to the atmosphere, and the concentration of organics remaining in the waste will decrease. For highly volatile organic compounds such as butadiene, all of the compound would evaporate within a few seconds of exposure to air. Similarly, emissions of organics from open waste transfer systems (e.g., sewers, channels, flumes) are expected to be very significant. To ensure that the determination of total organic concentration is an accurate representation of the emission potential of a waste upon generation, it is essential that the waste determination be performed at a point as near as possible to where the waste is generated, before any exposure to the atmosphere can occur.

For the reasons stated above, the waste determination must be based on the waste composition before the waste is exposed, either directly or indirectly, to the ambient air. Direct exposure of the waste to the ambient air means the waste surface interfaces with the ambient air. Indirect exposure of the waste to the ambient air means the waste surface interfaces with a gas stream that subsequently is emitted to the ambient air. If the waste determination is performed using direct measurement, the standards would require that waste samples be collected from an enclosed pipe or other closed system which is used to transfer the waste after generation to the first hazardous waste management unit. If the waste determination is performed using knowledge of the waste, the standards would require that the owner or operator have documentation attesting to the volatile organic concentration of the waste before any exposure to the ambient air.

The location where the waste determination would be made for any one facility will depend on several factors. One factor is whether the waste is generated and managed at the same site, or the waste is generated at one site and transferred to a commercial TSDF for management. Another important factor is the mechanism used to transfer the waste from the location where the waste is generated to the location of the first waste management unit (e.g., pipeline, sewer, tank truck). For example, if a waste is first accumulated in a tank using a direct, enclosed pipeline to transfer the waste from its generation process, then the waste determination could be made based on waste samples collected at the inlet to the tank. In contrast, if the waste is first accumulated in a tank using an open sewer system to transfer the waste from its generation process, then the waste determination would need to be made based on waste samples collected at the point where the waste enters the sewer before the waste is exposed to the ambient air. For situations where the waste is generated off-site, the owner or operator may make the determination at the inlet to the first waste management unit at the TSDF that receives the waste provided the waste has been transferred to the TSDF in a closed system such as a tank truck and the waste is not diluted or mixed with other waste.

If a waste determination indicates that the total organic concentration is equal to or greater than the applicability criteria, then the owner or operator would be required to comply with the standards.

Sampling methods are described in EPA's SW-846 manual on sampling and analytical methodologies and in other analytical methods.[1,2] In these methods, emphasis is placed on taking a sample from throughout the waste material to eliminate any possible effects of stratification. The methods also suggest that the most appropriate sampling method for volatile organics is to take the sample from below the surface of the liquid waste (e.g., 30.5 to 45.7 cm [12 to 18 in]) nearest the source of the waste discharge. The sample should be immediately stored in a vial such as a 40-mL volatile organic analysis (VOA) vial with a Teflon$^{R}$-lined septum or in a larger container such as a 224 g (8-oz) widemouth glass container with a Teflon$^{R}$ liner. The sample container should be filled completely with the waste to prevent volatile organics from partitioning into the headspace. The sample should be preserved and stored at cold temperatures (i.e., less than or equal to 4 °C [-15.5 °F]). Sample agitation should be minimized during handling. The sample should be analyzed within 14 days of collection.

In some instances, it is unknown if a waste to be sampled is stratified. In such cases, one should assume that the stream is stratified and attempt to obtain the sample either at a location where stratification would be minimized or at a point where the sample can be collected from the full container depth. When sampling from pipes, it is recommended to sample from a vertical stretch of the pipe when possible because the fluid here may be more completely mixed than the fluid in long horizontal sections where stratification may occur.

When sampling from either drums or tanks, one should attempt to obtain a core sample from the container. SW-846 recommends the use of a composite liquid waste sampler (the Coliwasa) to collect free-flowing liquids and slurries from drums or shallow tanks. For deeper tanks, other means may be required to extract the sample. For example, it may be necessary to place a weighted sample line into the tank and pump material through the line into a collection container as the line is lifted through the height of the tank volume. This allows collection of an integrated sample of the free-flowing material at different heights of the tank. Care must be exercised so that the collection flow rate is low enough to minimize any mixing of the tank contents. Efforts should also be made to identify the presence of and estimate the depth of solids on the tank bottom. Such solids may not be collected by this sampling approach, especially if they have become well compacted over a period of time.

Once a representative sample is secured, an analytical method must be chosen to measure the organic content of the waste. Several methods exist, and in some cases the choice of one method over another is not clear. Table 6-1 presents a list of methods suggested by the EPA for determining the organic content of waste liquids (Sections 264.1063[d] and 265.1063[d]). Some can be considered screening techniques; others, specialty techniques.

The most universally applicable method is the gas chromatographic techniques as described in ASTM E 260-85. With this method, the sample must be prepared to allow direct injection into the analytical instrument. The person responsible for the analysis needs to select the proper column and column operating conditions. Also, the gas chromatographer (GC) should be equipped with a detector that will give the best response to the particular component(s) being analyzed. Therefore, it is helpful to know the approximate composition of the waste prior to conducting the analysis. Table 6-2 lists several GC detectors and the types of organics that can be readily detected with each. For most purposes, a flame ionization detector (FID) is the best option for analyzing organic-containing materials.

ASTM D-2267-88 is a specialty GC procedure for aromatics in other organic solvents. Methods in SW-846 for GC analysis (8010 for halogenated volatile organics and 8020 for aliphatic volatile organics) are considered as an expansion of the general ASTM E 260-85 method and provide a good deal of specificity. Standards are usually run with the samples to provide

TABLE 6-1. APPLICABILITY OF ORGANIC CONTENT ANALYTICAL METHODS[3-8]

| Method | Compounds most applicable | Comments |
|---|---|---|
| ASTM E 260-85 (General GC analysis) | Multiple compounds | Method can be applied to many compounds, and analysis can be done with several diferent detectors. Possibly the most universally applicable method for this application. |
| ASTM D 2267-88 (Aromatics by GC) | Benzene, toluene, $C_8$, and heavier aromatics | Method was developed to measure aromatics in aviation gasolines, reformer products, and reformer feed. Based on GC techniques. Requires a standard for quantification. |
| Method 9060 (SW-846) (Total organic carbon [TOC]) | Organic carbon greater than 1 mg/L | Uses a carbonaceous analyzer to measure carbon content of water and domestic and industrial wastes. Could be used as a screening technique to determine approximate concentration of organics. |
| Method 8240 (SW-846) (Volatiles by gas chromatographer/mass spectrometer [GC/MS]) | Generally used to measure Appendix VIII compounds in waste waters, sludges, and soils | Based on purge-and-trap, GC/MS procedure. Only volatile compounds will be identified. Relatively expensive test procedure. |
| ASTM E 168-88 (Infrared [IR] analysis) | Single or double component systems | Similar to UV technique except sample can be a "mull" mixture or a solid transparent disk. May not provide the quantitative information required by the regulation. |
| ASTM E 169-87 (Ultraviolet [UV] analysis) | Single or double component system | Method requires that measured compounds be soluble in a "non-interfering" solvent. The absorbance characteristics of the compounds must be known. May not provide the information required by the regulation. |

## TABLE 6-2. APPLICABILITY OF ORGANIC ANALYTICAL DETECTORS

| Detector | Organic compounds most applicable | Comments |
|---|---|---|
| Flame ionization | All | Certain substituted compounds, like chlorinated compounds, have low responses. |
| Photoionization | Aromatics | Works well for most aromatic compounds. Will not detect low molecular weight hydrocarbons. |
| Hall electrolytic conductivity device | Halogenated | Mostly chlorination and brominated compounds; low response for fluorinated compounds. |
| Nondispersive infrared | Any compound with C-H band | Compounds need to absorb IR, and IR wavelengths need to be known. Other compound such as $CO_2$, $SO_2$, and water can interfere. |
| Mass spectrometer | All | Most expensive technique. Usually used to confirm identification of compounds. |

quantitative data; however, the compound is identified only by retention time, thus making possible false positive identifications.

An additional, more expensive analysis for volatile organics is GC/MS according to EPA Method 8240. This method offers not only the reference of retention time, but also the mass spectra for component confirmation. The GC/MS analysis also provides quantitative information.

The TOC analysis (EPA Method 9060) provides an easy determination of total organic content. When using this technique, samples with high concentrations of organics will require dilution with water or a nonorganic solvent before being analyzed. Some TOC analyzers have an upper range of 0.1 percent total organics; therefore, a 100:1 dilution with water (or other appropriate nonorganic solvent) should result in a sample concentration that is within the instrument range.

The UV and IR analysis methods presented in Table 6-1 (ASTM E-169-87 and ASTM E-168-88, respectively) are used as qualitative tools for compound identification. The IR procedure appears to provide better aliphatic organic compound information; however, halogenated components may not be identified from the IR analysis. Moreover, the IR analysis may not provide the required quantitative information. The UV methodology is not used as often and may require some investigation and review to confirm its applicability.

The procedures referenced in Table 6-1 provide specific compound identification capabilities for volatile organics with either GC or GC/MS. For semivolatile component analysis, TOC and IR have been identified in the regulation. Other alternative procedures not identified in the regulation (i.e., GC/MS [SW-846 Method 8240]) may be used. The choice of methods will depend on the specific compounds to be analyzed for and the type of results that are desired.

The location of a laboratory or the lack of on-site analysis equipment may dictate the methodology to be used for analysis. GC/MS instrumentation is expensive and less portable than other instrumentation available for organic analysis. The method to be used should be chosen based on the applicability to a particular waste stream and on any matrix limitations specified in the method. If appropriate, cost may be used as a secondary criterion. Also, owners or operators may use engineering judgment to determine total organic content, but they must be able to justify their decisions and are at risk if their judgment is incorrect.

The equipment leak rules do not specify the number of samples that must be analyzed for the 10-percent organic content waste determination. This is because the determination of Subpart BB applicability should not require precise measurement of the 10-percent total organics by weight in most cases. The EPA anticipates that most waste streams will have an organic content much lower or much higher than 10 percent. Furthermore, because the regulation requires control if the organic content of the waste stream ever equals or exceeds the 10-percent value, EPA believes that few owners or operators will claim that a waste stream is not subject to the requirements of the standards based on a sample analysis with results near 10 percent. Therefore, a precise measurement of waste stream total organic content is not likely to be needed to determine applicability of the equipment leak standards.

### 6.1.2 Gaseous Waste Streams

The analysis of a gaseous waste stream can be performed on-site using a real-time measurement, or off-site when grab samples are used. The on-site approach is generally preferred when there is a continuous stream with a significantly varied composition. In this case, the analyzer takes a continuous or nearly continuous sample, which is directly analyzed for total organic concentration. The sample must be delivered to the analyzer through a leak-free sample line and gas sample pump. For off-site measurement (and sometimes on-site measurement), a vent gas/vapor grab sample will be collected in a clean inert container. The most common containers are stainless steel sampling bombs (2 to 5 L [0.5 to 1.3 gal] in size), glass bombs, or Tedlar$^R$ bags of similar or larger size. The sample can be taken instantaneously or as an integrated sample if a flow regulator is used to slowly bleed the sample into the sample container. The containers must be sealed before shipment to the off-site analytical laboratory. Also, the sample containers should be routinely tested for leaks and contamination.

GC techniques are the most common analysis methods for gas-phase measurement. The recommended method is EPA Method 18, Measurement of Gaseous

Organics by Gas Chromatography.[9] This method is applicable to 90 percent of the types of gaseous organics emitted from an industrial or hazardous waste source and has a precision of 5 to 10 percent (relative standard deviation). This method, however, is not able to identify and measure trace amounts of organic compounds, such as those found in indoor air and fugitive emissions.

As in the GC techniques for liquid wastes, Method 18 allows the use of the most appropriate detector. The detector selection guidelines presented in Table 6-2 are applicable to gaseous waste stream measurements.

### 6.1.3 Light/Heavy-Liquid Determination

After the 10-percent organic determination has been made, all liquid streams containing 10 percent or greater organics must undergo a light-liquid/heavy-liquid determination. Light liquids are those that contain one or more compounds with a vapor pressure greater than 0.3 kPa (0.04 psia) at 20 °C (68 °F) and the total concentration of pure components having a vapor pressure greater than 0.3 kPa at 20 °C is greater than 20 percent and are a liquid at operating temperatures (see Figure 6-1). All liquids that do not meet these criteria are considered heavy liquids.

The light-liquid determination will require that compound-specific data be known for the waste. Vapor pressures must be determined for each compound in the waste. Vapor pressures are listed in the chemical literature for most common compounds. An analysis method for determining the vapor pressure of a compound for which the vapor pressure is not available in the literature is ASTM D 2879-8. If the waste contains a compound or compounds with vapor pressure greater than 0.3 kPa at 20 °C, such as the common organic solvents shown in Table 6-3, the concentrations of the compounds will have to be determined. For streams of unknown composition, the owner/operator can either analyze the stream to make a complete determination or make an engineering estimate of the stream composition. Complete analysis is usually conducted using GC/MS, which is relatively sophisticated and costly (i.e., $1,500 to $2,500 per sample).

Visual observation can be used to determine whether a waste is a liquid at ambient temperature. This could be done by an experienced operator or technician by examining flowability of the fluid or possibly by measuring viscosity. The owner or operator may be required to provide documentation to support engineering judgment used to determine material fluidity.

TABLE 6-3. VAPOR PRESSURES OF COMMENT SOLVENTS

| | VP @ 20°C, kPa (mm Hg) | | Most appropriate analytical method |
|---|---|---|---|
| Halogenated Solvents | | | |
| Methylene chloride | 45.2 | (340) | EPA Method 8240 |
| 1,1,1-Trichloroethane | 2.3 | (17) | EPA Method 8240 |
| Trichloroethylene | 7.8 | (59) | EPA Method 8240 |
| Perchloroethylene | 1.7 | (13) | EPA Method 8240 |
| Methyl ethyl ketone | 9.4 | (70.6) | EPA Method 8240 |
| Methyl isobutyl ketone | 2.1 | (16) | EPA Method 8240 |
| Toluene | 5.1 | (38) | EPA Method 8240 |
| Acetone | 24.6 | (185) | EPA Method 8240 |
| Xylene(s) | 1.3 | (9.5) | EPA Method 8240 |
| Mineral spirits | 0.27 | (2.0) | ASTM E 260 |
| Alcohols | | | |
| Isopropyl alcohol | 4.1 | (31) | ASTM E 260 |
| Methanol | 12.7 | (96) | ASTM E 260 |
| Ethanol | 5.9 | (44) | ASTM E 260 |

VP = vapor pressure.

### 6.1.4 Leak Detection Monitoring

Once a waste stream has been classified as gas/vapor, light liquid, or heavy liquid, the next step will be to determine the proper leak detection program for the source. The recommended screening method is EPA Method 21[11] (Section 264.1063[b]). See Appendix B for a description of Method 21. With Method 21, a hand-held total organic analyzer is used to locate leaks from sources such as valves, flanges, and pump seals. A leak is defined as a certain concentration, based on a reference compound (methane or n-hexane), and is specified for each source in the TSDF regulation. In addition, a response factor must be determined for each compound that is to be measured, either by testing or from reference methods.[11] Appendix G presents the results of a laboratory study on the sensitivity (i.e., response factors) of two portable VOC analyzers to a variety of organic chemicals. The data from the screening survey are recorded on sheets similar to the one shown in Table 6-4.

Appendix H provides a general guide to portable VOC detection devices that are being marketed for various uses. The instruments in this appendix are classified as ionization detectors, infrared detectors, or combustion detectors.

In the following subsections each source type is discussed and the required monitoring program briefly presented.

6.1.4.1 Valves and Pumps in Light-Liquid Service. Valves and pumps in light-liquid service will require the use of Method 21 protocol. The monitoring instrument is calibrated in terms of parts per million by volume (ppmv) of methane or n-hexane in the case of Subpart BB regulations. The detection level for a leak is 10,000 ppmv as measured by the monitoring instrument organic analyzer. In the case of pumps, the analyzer sample probe is held 1 cm (0.4 in) from the emission source, usually at the pump seal and shaft interface. For valves, emissions are measured directly on the source, usually between the valve stem and the housing.

Pumps with a dual mechanical seal and barrier fluid require only visual inspection on a weekly basis if the barrier fluid system meets the requirements of Section 264.1052(d). Sealless pumps are exempted from any monitoring requirements if the instrument reading upon initial inspection is less than 500 ppm above background (Section 264.1052[e]). Pumps that are

TABLE 6-4. EXAMPLE SOURCE SCREENING DATA SHEET

SOURCE SCREENING DATA SHEET:

DATE: ________ PLANT: ________ Screening Team: ___, ___, ___

| Seq. No. | Comp. Type | Flow Sheet No. | Location I.D. | Process Stream | Service Type[a] | Screening Value (ppm) | Visible Leak (Y/N) | Comments |
|---|---|---|---|---|---|---|---|---|
| ____ | ____ | ____ | ________ | ______ | ______ | ________ | ______ | ________ |
| ____ | ____ | ____ | ________ | ______ | ______ | ________ | ______ | ________ |
| ____ | ____ | ____ | ________ | ______ | ______ | ________ | ______ | ________ |
| ____ | ____ | ____ | ________ | ______ | ______ | ________ | ______ | ________ |
| ____ | ____ | ____ | ________ | ______ | ______ | ________ | ______ | ________ |
| ____ | ____ | ____ | ________ | ______ | ______ | ________ | ______ | ________ |
| ____ | ____ | ____ | ________ | ______ | ______ | ________ | ______ | ________ |
| ____ | ____ | ____ | ________ | ______ | ______ | ________ | ______ | ________ |
| ____ | ____ | ____ | ________ | ______ | ______ | ________ | ______ | ________ |
| ____ | ____ | ____ | ________ | ______ | ______ | ________ | ______ | ________ |
| ____ | ____ | ____ | ________ | ______ | ______ | ________ | ______ | ________ |
| ____ | ____ | ____ | ________ | ______ | ______ | ________ | ______ | ________ |
| ____ | ____ | ____ | ________ | ______ | ______ | ________ | ______ | ________ |
| ____ | ____ | ____ | ________ | ______ | ______ | ________ | ______ | ________ |

[a] Gas, light-liquid, heavy-liquid.

Component types:

Valve = VLV
Relief valve = RLV
Pressure sensitive valve = PSV
Pumps = PMP
Compressors = COM
Open-ended line = OEL

equipped with a closed-vent system capable of capturing and transporting any leakage to a control device are exempt from all monitoring requirements (Section 264.1052[f]).

6.1.4.2 Valves in Gas/Vapor Service. Valves in gas/vapor service (Section 264.1057) will require the use of EPA Reference Method 21 as outlined above for the valves and pumps in light-liquid service.

6.1.4.3 Pressure Relief Devices in Gas/Vapor Service. Pressure relief devices in gas/vapor service (Section 264.1054) require monitoring for "no detectable emissions" as described in EPA Method 21. Pressure relief devices are required to be preceded by rupture disks, which will considerably reduce the possibility of leaks. Good operating practice includes the use of a "tell-tale" pressure gauge between the rupture disk and pressure relief device to indicate the integrity of the rupture disk. The final rule requires that pressure relief devices in gas/vapor service be monitored within 5 days after each discharge.

6.1.4.4 Pipeline Flanges (and Other Connectors) and Pressure Relief Devices in Light-Liquid Service and Equipment in Heavy-Liquid Service. Pipeline flanges (and other connectors) and pressure relief devices in light-liquid service and equipment in heavy-liquid service (Section 264.1058) are required to be monitored after an "audible, visual, olfactory, or other detection method" indicates the presence of a leak. "Equipment" is defined as each valve, pump, compressor, pressure relief device, sampling connection system, open-ended valve or line, flange, or accumulator vessel, and any control devices or systems required by the regulation. If a leak is detected, the owner/operator must use EPA Method 21 to determine whether the leak meets the regulatory definition (i.e., greater than 10,000 ppmv).

6.1.4.5 Closed-Vent Systems. Closed-vent systems (Section 264.1060) are used to vent emissions to a control device such as a flare or carbon adsorber. A closed vent must be monitored after construction to demonstrate that the system operates with no detectable emissions (less than 500 ppmv).

### 6.1.5 Equipment Requirements for Minimizing Leaks

Certain pieces of equipment do not require leak detection monitoring; rather, they require addition of specific control equipment for leak prevention. These are shown in Table 6-5. In all cases, these requirements apply only to sources that meet the 10-percent-by-weight organic content

TABLE 6-5. EQUIPMENT REQUIREMENTS FOR REDUCING PROCESS LEAKS

| Type of equipment | Control requirement |
|---|---|
| Compressors (Section 264.1053) | Use mechanical seals with barrier fluid systems and control degassing vents. The degassing vent control must use a closed-vent system and a control device that complies with the process vent requirements of the regulation.<br>The barrier fluid system must be equipped with a sensor that will detect failure of the system. The sensor must be equipped with an audible alarm or inspected daily. |
| Sampling connection system (Section 264.1055) | Closed purge sampling is the required standard for sampling connection systems. Collected purge material must be destroyed or recovered in a system that complies with the process vent requirements of the regulation. |
| Open-ended valves or lines (Section 264.1056) | Open-ended valves or lines require the use of caps, plugs, or any other equipment that will effect enclosure of the open end. |

criterion. The compressor requirement applies to gas-service applications. The regulations make no distinction on type of service for sample collection systems or open-ended valves or lines.

## 6.2 PROCESS VENTS

A process vent is defined as "any open-ended pipe or stack that is vented to the atmosphere either directly, through a vacuum-producing system, or through a tank (e.g., distillate receiver, condenser, bottoms receiver, surge control tank, separator tank, or hot well) associated with distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping operations." The final rules require that each affected TSDF (i.e., those with waste management units of the type specified in the rules that manage hazardous waste with 10 ppmw or greater total organics concentration on a time-weighted, annual average basis) (a) reduce total organic emissions from all affected vents below 1.4 kg/hr (3 lb/h) and below 2.8 Mg/yr (3.1 ton/yr), or (b) reduce total organic emissions from all affected vents at the facility by 95 weight percent, or, for enclosed combustion devices, to a total organic compound concentration of 20 ppmv or less (expressed as sum of actual compounds, on a dry basis corrected to 3 percent oxygen).

The following subsections discuss sampling and analysis procedures that may be used to determine the organic content of the waste stream and the process vent emissions and how to calculate the maximum hourly and annual emission rates from individual process vents.

### 6.2.1 Waste Stream Determination

To determine whether a particular hazardous waste management unit of the type specified in the rule (e.g., a steam stripping or air stripping unit) is subject to the provisions of Subpart AA of Parts 264 and 265, the owner/operator is required to determine the total organic concentration of the waste managed in the unit initially (by the effective date of the standards or when the waste is first managed in the waste management unit) and thereafter on a periodic basis (for continuously generated wastes). A waste determination for Subpart AA applicability would not be necessary when an owner/operator manages the waste in a distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping unit that is controlled for organic emissions and meets the substantive requirements of Subpart AA.

Determination that the time-weighted, annual average total organic concentration of the waste managed in the unit is less than 10 ppmw must be performed by direct measurement or by knowledge of the waste as described later in this section. Direct measurement of the waste's total organic concentration must be performed by collecting individual grab samples of the waste that are representative of the waste stream managed in the potentially affected unit and analyzing the samples using one of the approved reference methods identified in the rule.

The EPA is requiring that analytical results for a minimum of four (4) representative samples be used to determine the total organic concentration for each waste stream managed in the unit. In setting the minimum number of samples at four, EPA will obtain sufficient data to characterize the total organic concentration of a waste without imposing an unnecessary burden on the owner/operator to collect and analyze the samples.

Waste determinations must be performed under process conditions expected to result in the maximum waste organic concentration. For waste generated on-site, the samples must be collected at a point before the waste is exposed to the atmosphere such as in an enclosed pipe or other closed system that is used to transfer the waste after generation to the first affected distillation/separation operation. For waste generated off-site, the samples must be collected at the inlet to the first waste management unit that receives the waste, provided the waste has been transferred to the facility in a closed system such as a tank truck, and the waste is not diluted or mixed with other waste.

The location where the waste's total organic content is determined is of importance since sampling location can greatly affect the results of the determination. This occurs because the concentration level can decrease significantly after generation as the waste is transferred to (and managed in) various waste management units. If the waste is directly or indirectly exposed to ambient air at any point, a portion of the organics in the waste will be emitted to the atmosphere, and the concentration of organics remaining in the waste will decrease. For highly volatile organic compounds such as butadiene, all of the compound would evaporate within a few seconds of exposure to air. To ensure that the determination of total organic concentration is an accurate representation of the emission potential of a waste, it is essential that the waste determination be performed at a point as near as possible to where the waste is generated, before any exposure to the atmosphere can occur.

For the reasons stated above, the waste determination must be based on the waste composition before the waste is exposed, either directly or indirectly, to the ambient air. Direct exposure of the waste to the ambient air means the waste surface interfaces with the ambient air. Indirect exposure of the waste to the ambient air means the waste surface interfaces with a gas stream that subsequently is emitted to the ambient air. If the waste determination is performed using direct measurement, the standards would require that waste samples be collected from an enclosed pipe or other closed system which is used to transfer the waste after generation to the first hazardous waste management unit. If the waste determination is performed using knowledge of the waste, the standards would require that the owner or operator have documentation attesting to the organic concentration of the waste before any exposure to the ambient air.

The location where the waste determination would be made for any one facility will depend on several factors. One factor is whether the waste is generated and managed at the same site, or the waste is generated at one site and transferred to a commercial TSDF for management. Another important factor is the mechanism used to transfer the waste from the location where the waste is generated to the location of the first waste management unit (e.g., pipeline, sewer, tank truck). For example, if a waste is first accumulated in a tank using a direct, enclosed pipeline to transfer the waste from its generation process, then the waste determination could be made based on waste samples collected at the inlet to the tank. In contrast, if the waste is first accumulated in a tank using an open sewer system to transfer the waste from its generation process, then the waste determination would need to be made based on waste samples collected at the point where the waste enters the sewer before the waste is exposed to the ambient air. For situations where the waste is generated off-site, the owner or operator may make the determination at the inlet to the first waste management unit at the TSDF that receives the waste provided the waste has been transferred to the TSDF in a closed system such as a tank truck and the waste is not diluted or mixed with other waste. If a waste determination indicates that the total organic concentration is equal to or greater than the applicability criteria, then the owner or operator would be required to comply with the standards.

Methods used to measure the organic content of liquid and gaseous waste streams are discussed in Sections 6.1.1 and 6.1.2, respectively; these methods also apply to measurement of the waste for the 10 ppmw applicability criterion of Subpart AA and the determination of the organic content of the process vent emission stream.

As an alternative to using direct measurement, an owner/operator is allowed to use knowledge of the waste as a means of determining that the total organic concentration of the waste is less than 10 ppmw. Examples of information that might be considered by EPA to constitute sufficient knowledge include: (a) documentation that organics are not involved in the process generating the waste; (b) documentation that the waste is generated by a process that is identical to a process at the same or another facility that has previously been determined by direct measurement to have a total organic content less than 10 ppmw; or (c) previous speciation analysis results from which the total concentration of organics in the waste can be computed. The finals standards include the provision that EPA can require that the waste be analyzed using Method 8240 if EPA believes that the documentation is insufficient to determine an exception by knowledge of the waste (Sections 264.1034, 264.1063, 265.1034, and 265.1063).

In order to address the temporal variability that can occur both within a particular waste stream and within the various waste streams managed in a hazardous waste management unit, the final rules require a time-weighted, annual average concentration to characterize the waste managed in the unit. An annual average organic concentration cutoff was judged by EPA to be reasonable for minimizing increases in organic emissions resulting from minor organic fluctuations in the waste stream. The final rules require that an owner/operator repeat the waste determination whenever there is a change in the waste being managed or a change in the process that generates or treats the waste that may affect the regulatory status of the waste management unit or, if the waste and process remain constant, at least annually. For example, continuous processes are more likely to generate a more homogeneous waste than batch operations; batch operations involve processes that may frequently involve change in materials or process conditions. Batch operations, therefore, usually generate wastes with varying characteristics, including such characteristics as organics content. Ground-water concentrations would also be expected to show significant variation if more than one well provides influent to a waste management unit such as an air stripper and the wells that feed the unit are varied over time or if the proportions from the wells that make up the influent are changed. This is because there is typically considerable spatial variability in contaminated ground-water concentrations. Situations where the feed streams are changed and the change is not accounted for in the initial waste determination would be considered a process change or change in the waste managed that would require a new determination.

With the time-weighted, annual average applicability criterion, a hazardous waste management unit would not be subject to the process vent rule if it occasionally treats wastes that exceed 10 ppmw if at other times the wastes being treated in the unit were such that the weighted annual average total organic concentration of all wastes treated is less than 10 ppmw. The time-weighted, annual average is calculated using the annual quantity of each waste stream managed in the unit and the mean organic concentration of the waste stream. For example, an air stripper located at a TSDF treats an influent comprised of three hazardous waste streams. Two of the feed streams are dilute aqueous waste streams (i.e., wastewaters) with organic concentrations of X=7 ppmw and Y = 20 ppmw. The total volumes requiring treatment in the unit during the year are 100 million gallons for stream X and 75 million gallons for stream Y. The remaining stream treated by the air stripper is a (hazardous waste) ground-water stream with an estimated maximum organic concentration of Z = 1.0 ppmw and a maximum pumping rate of 670 gallons per minute (i.e., 350 million gallons per year require treatment in the unit). The total waste stream flow to the air stripper is about 1,000 gallons per minute, and the unit is expected to run continuously throughout the year. Calculation shows that the annual weighted average organic concentration is about 5 ppmw. Since the waste managed in the unit is less than 10 ppmw, this unit is not covered by the process vent standards of Subpart AA. (Note: The unit would have organic emissions of about 2 lb/h.)

### 6.2.2 Emission Rate Estimate

Determinations of process vent emissions and emission reductions or total organic compound concentrations achieved by add-on control devices may be based on either engineering calculations or source performance tests. If performance tests are used to determine vent emissions, emission reductions, or total organic compound concentrations achieved by add-on control devices, they must conform to the requirements in Section 264.1034(c) or Section 265.1034(c). Under these requirements, each performance test must consist of three separate runs; each run is to be conducted for at least 1 hour under the conditions that exist when the hazardous waste management unit is operated at the highest load or capacity level reasonably expected to occur.

To calculate the emission rate on an hourly (and yearly) basis, the flow rate of each of the affected process vent streams will have to be determined. EPA Method 2 in 40 CFR Part 60 is the specified procedure for velocity and volumetric flow rate measurement. Table 6-6 presents the capabilities and limitations of this method. This table also lists several alternative methods that may be used to comply with the continuous monitoring requirement specified in Section 264.1033(f)(1). EPA Method 18 in 40 CFR Part 60 is the specified procedure for organic content measurements.

Once the process vent organic content and gas flow rate of the process vent stream have been measured, these data can be used to calculate the emission rate. Table 6-7 presents a general formula for the emission rate calculation. The hourly emission rate should be based on the maximum expected emission from the source. The yearly emission rate is based on the total emissions expected from the facility; therefore, the calculation will be based on the hourly emission and the yearly hours of operation.

The process vent organic content and gas flow rate must be measured under conditions that result in the maximum total organic emissions from the subject vent. Process conditions such as temperature, pressure, and flow rate and the concentration of organics in the waste stream should be adjusted to generate the maximum quantity of total organic emissions from the process vent while still remaining within the range of normal anticipated operating conditions. For example, a solvent recycler may be permitted to receive a wide variety of liquid solvent wastes for processing. This recycler could have a process vent on a condenser located at the top of

TABLE 6-8. APPLICABILITY OF FLOW MEASUREMENT METHODS[12-18]

| Method | Duct diameter cm (in) | Flow velocity m/min (fpm) | Accuracy | Other |
|---|---|---|---|---|
| EPA Methods 1 and 2 (S-type pitot) | >30 (>12) | 180-1,525<br>(600-5,000) | ± 3%, >915 m/min<br>± 5-8%, 180-305 | Cannot be used in cyclonic flow or near flow disturbance.<br>m/min |
| EPA Method 1A | <30 and >10 | Similar to (<12 and >4) | Similar to Method 1 | Can be used closer to flow Method 1 disturbances than Method 1. |
| EPA Method 2A (Dry gas meter/wet test meter/Roots meter) | Small | Generally low flow | ± 2% | Will measure the entire flow accurately. |
| EPA Method 2B (stoichiometry) | NA | Calculate flow rate based on | Unknown<br>combustion stoichiometry | Only used on combustion sources. |
| EPA Method 2C (standard pitot) | <30 and >10<br>(<12 and >4) | Similar to Method 2 | Similar to Method 2 | Applicable to exhaust gas volumes from incinerators. |
| EPA Method 2D (rotameter or orifice plate) | Depends on size of metering device | Depends on size of metering device | ± 5 percent | Will measure the entire flow. |
| Hot wire anemometer | <0.81 (<32)[a] | 0-1,030 | ± 2%[b] | Fragile instrument that requires routine calibration. Dangerous in presence of explosive/ flammable organic concentrations. |
| Bubble meter | Very small | Generally low | ± 2% | Convenient for low-flow, small volume streams. |

NA= Not applicable.

[a] Length of probe.

[b] Reported by manufacturer.

## TABLE 6-7. EXAMPLE EMISSION RATE CALCULATION

Hourly emission rate ($E_h$) = kg/h (lb/h)

Hourly emission rate = Flow rate ($m^3/s$) X Organic conc. (ppm) X Avg MW (kg/g-mole)
(maximum) X Conversion factors

$$E_h = Qsd \left[ \sum_{i=1}^{n} Ci\ MWi \right] (0.0416) \left[10^{-6}\right]$$

$Qsd^a$ = Volumetric flow rate of gases entering or exiting control device, as determined by Method 2, dscm/h

$Ci^a$ = Organic concentration in ppm, dry basis, of compound i in the vent gas, as determined by Method 18

n = Number of organic compounds in the vent gas

MWi = Molecular weight of organic compound i in the vent gas, kg/kg-mole

0.0416 = conversion factor for molar volume, kg-mole/$m^3$ (@ 293 K and 760 mm Hg)

$10^{-6}$ = Conversion from ppm, $ppm^{-1}$

$$E_h = kg/h\ (X\ 2.205 = lb/h)$$

Yearly emission rate = Maximum hourly rate X Number of operating hours per year

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[a] Time-weighted average of the three test runs required under Section 264.1034(c) and Section 265.1034(c).

a stripping column. The organic emissions from this vent would probably be maximized when the column operates at the maximum anticipated feedrate and processes a waste that has the maximum anticipated concentration of volatile (i.e., low boiling point) organic constituents.

The facility's process vent emission rate determination must be appropriate at all times to the facility's current waste management unit designs and wastes managed. If the owner/operator takes any action that would result in the determination no longer reflecting the facility's operations (e.g., if a waste of different composition is managed, the operating hours of the affected management units are increased beyond what was originally considered, or a new affected unit is added), then a new emission rate determination is required (Sections 264.1035, 264.1064, 265.1035, and 265.1064).

### 6.2.3 Control Device Performance Monitoring

If the facility hourly or yearly process vent emission rate exceeds the limits in the regulation, then controls will be required to reduce emissions to below the limit, or to reduce total organic emissions from all affected vents at the facility by 95 weight percent. If an incinerator, boiler, or process heater is used as a control device, the volume concentration standard of 20 ppmv can be met instead of the 95-weight-percent reduction. (Note: The provisions in this section also apply to vented emissions from equipment leak controls on pumps, compressors, sampling connection systems, etc.) The vented emissions must be transported to a control device by a closed-vent system (see Section 6.1). The control device efficiency will be determined by estimating the mass of organics entering and the mass of organics exiting the same control device. The control device efficiency determination can be made using engineering calculations (mass balance) or an actual performance test.

An owner or operator should anticipate that performance calculations based on engineering judgment will require support documentation, and such documentation should be maintained in the operating record and furnished along with the permit application. As an example, removal efficiency calculations should use equations and procedures taken from accepted engineering design publications. The details of the calculations should be presented with appropriate references. Under some circumstances, vendor performance guarantees may be accepted in place of detailed engineering calculations. As an example, a vendor may have a proven track record on similar applications, or may be able to substantiate guarantees with performance data collected from tests on similar applications.

A performance test, if conducted, will require the measurement of the total organic content and gas flow rate into and out of the control device. The test procedures that have been presented for gas-phase total organic content and velocity (flow rate) measurement should be used for the performance test (e.g., Method 2 for velocity and flow rate and Method 18 for organic content). A performance test should include at least three 1-h test periods during maximum system operation. The total organic reduction efficiency would be estimated for each 1-h period, and an average of the three values would represent the system performance at maximum conditions.

The owner or operator also is required to continuously monitor the control device to ensure that it is operating within design specifications. Table 6-8 lists possible controls, required monitoring parameters, and monitoring methods. The relationship between the total organic reduction and control device operating parameters can be established during the performance test or by engineering estimations. The owner or operator must keep a logbook that includes the dates when the control device operated outside of design specifications as indicated by the control device monitoring, the duration of operation outside of design specifications, the cause, and corrective measure(s) taken. This log should also contain information and data identifying all affected process vents, annual facility throughput, annual facility operating hours, and estimated emissions for each affected vent and for the overall facility.

## 6.3 QUALITY ASSURANCE AND QUALITY CONTROL

The initial steps for any sampling or analytical work should be to define the objectives or goals of the work. After these have been established, a quality control (QC) and quality assurance (QA) program can be developed to ensure that the data produced meet the goals and objectives of the sampling/testing program. The responsibility of ensuring that the QA/QC measures are properly employed must be assigned to a knowledgeable person who is not directly involved in the sampling or analysis.

TABLE 6-8. PROCESS VENT CONTROL DEVICE MONITORING METHODS AS SPECIFIED BY SECTION 264.1033(f)

| Control device | Required monitoring | Method[a] |
|---|---|---|
| Flares | Pilot light flame detection<br>Visible emissions | Thermocouples<br>Method 22[b] |
| Thermal incinerators | Combustion chamber temperature downstream of combustion zone | Thermocouples |
| Catalytic incinerators | Vent temperatures at nearest feasible point to catalyst bed inlet and outlet | Thermocouples |
| Boilers <44 MW | Furnace temperature downstream of flame zone | Thermocouples |
| Boilers >44 MW | A parameter that demonstrates good combustion operating practices are being used | Thermocouples for temperature monitors for CO or $NO_x$ |
| Condensers | Concentration of organics in the exhaust vent<br>or<br>Coolant and exhaust vent temperature sensors | Nonmethane hydrocarbon analyzer, Method 18<br>or<br>Thermocouples, dial thermometers |
| Carbon adsorbers | Concentration of organics in exhaust vent<br>or<br>A parameter that demonstrates that the bed is regenerated on a regular basis (for automatic regeneration), or replace the bed on a regular basis | Nonmethane hydrocarbon analyzer, Method 18<br>or<br>(Application specific) |
| Any control device | Vent stream flow | See Table 6-6 |

[a] Unless otherwise indicated, these methods are not specified by Section 264.1033(f) and should be regarded as examples only.

[b] Specifically required by Section 264.1033(f).

Some of the elements of a QA program that should be defined or established before any sampling or analysis is conducted include: sampling procedures (including field QC); sample custody; calibration procedures and frequency; analytical procedures (including laboratory QC); data reduction, validation, and reporting; internal QC checks; performance and system audits; and specific routine procedures used to assess data precision, accuracy, and completeness. These elements along with additional QA elements are described in EPA's SW-846 manual. Also described in SW-846 are general QC procedures for obtaining field samples and for laboratory analyses (e.g., duplicates, spikes, blanks).

Standard test methods generally contain information on specific QC procedures that pertain to that method. Careful adherence to these procedures and others established as part of a site-specific QA/QC program will likely result in obtaining appropriate samples and accurate analysis of these samples.

## 6.4 REFERENCES

1. U.S. EPA. Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., revised. U.S. Environmental Protection Agency, Washington, DC. September 1986.

2. U.S. EPA. EPA Reference Method, "Headspace Method" (Unpublished). U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emissions Measurement Branch, Research Triangle Park, NC. October 1988.

3. ASTM. The ASTM Annual Book of Standards, Section 14, Volume 14.01. ASTM E 169-63 (updated by ASTM D 169-87), "General Techniques of Ultraviolet Quantitative Analysis." American Society for Testing and Materials, Philadelphia, PA. 1984. p. 209-214.

4. ASTM. The ASTM Annual Book of Standards, Section 14, Volume 14.01. ASTM E 168-67 (updated by ASTM E168-88), "General Techniques of Infrared Quantitative Analysis." American Society for Testing and Materials, Philadelphia, PA. 1984. p. 200-208.

5. ASTM. The ASTM Annual Book of Standards, Section 14, Volume 14.01. ASTM E 260-73 (updated by ASTM E 260-85), "General Gas Chromatography Procedures." American Society for Testing and Materials, Philadelphia, PA. 1984. p. 382-400.

6. ASTM. The ASTM Annual Book of Standards, Part 24. ASTM D 2267-68 (updated by ASTM D 2267-83), "Aromatics in Light Naphthas and Aviation Gasolines by Gas Chromatography." American Society for Testing and Materials, Philadelphia, PA. 1978.

7. U.S. EPA. EPA Method 9060, "Total Organic Carbon," Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., revised. U.S. Environmental Protection Agency, Washington, DC. September 1986. p. 9060-1 to -5.

8. U.S. EPA. EPA Method 8240, "GC/MS Method for Volatiles," Test Methods for Evaluating Solid Waste, SW-846, 3rd ed., revised. U.S. Environmental Protection Agency, Washington, DC. September 1986. p. 8240-1 to -43.

9. U.S. EPA. EPA Reference Method 18, "Measurement of Gaseous Organic Compound Emissions by Gas Chromatography." 40 CFR 60, Appendix A, revised as of July 1, 1987. p. 740-769.

10. ASTM. The ASTM Annual Book of Standards, Section 5, Volume 05.02. ASTM D 2879-83 (updated by ASTM D 2879-86), "Vapor Pressure - Temperature Relationship and Initial Decomposition Temperature of Liquids by Isoteniscope." American Society for Testing and Materials, Philadelphia, PA. 1986. p. 610-617.

11. U.S. EPA. EPA Reference Method 21, "Determination of Volatile Organic Compound Leaks." 40 CFR 60, Appendix A, revised as of July 1, 1987. p. 504-511.

12. U.S. EPA. EPA Reference Method 1, "Sample and Velocity Traverses for Stationary Sources." 40 CFR 60, Appendix A, revised as of July 1, 1987. p. 504-511.

13. U.S. EPA. EPA Reference Method 2, "Determination of Stack Velocity and Volumetric Flow Rate (Type S Pitot Tube)." 40 CFR 60, Appendix A, revised as of July 1, 1987. p. 511-529.

14. U.S. EPA. EPA Reference Method 1A, "Sample and Velocity Traverses for Stationary Sources with Small Stacks or Ducts." Proposed addition to 40 CFR 60, Appendix A. 1988.

15. U.S. EPA. EPA Reference Method 2A, "Direct Measurements of Gas Volume Through Pipes and Small Ducts." 40 CFR 60, Appendix A, revised as of July 1, 1987. p. 529-532.

16. U.S. EPA. EPA Reference Method 2B, "Determination of Exhaust Gas Volume Flow Rate from Gasoline Vapor Incinerators." 40 CFR 60, Appendix A, revised as of July 1, 1987. p. 532-533.

17. U.S. EPA. EPA Reference Method 2C, "Determination of Stack Gas Velocity and Volumetric Flow Rate in Small Stacks or Ducts (Standard Pilot)." Proposed addition to 40 CFR 60, Appendix A. 1988.

18. U.S. EPA. EPA Reference Method 2D, "Measurement of Gas Volumetric Flow Rates in Small Pipes and Ducts." Proposed addition to 40 CFR 60, Appendix A. 1988.

19. U.S. EPA. EPA Reference Method 22, "Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares." 40 CFR 60, Appendix A, revised as of July 1, 1987. p. 790-794.

# 7.0 INSPECTION, MONITORING, RECORDKEEPING, AND REPORTING

## 7.1 INSPECTION AND MONITORING

Under the general RCRA inspection requirements (Sections 264.15 and 265.15), the owner/operator of a facility is required to inspect his facility for malfunctions, deterioration, operator errors, and discharges that could result in hazardous waste release or threat to human health. The owner/operator is responsible for developing and following an inspection schedule and for maintaining a copy of the schedule at the facility.

Each TSDF owner/operator subject to the provisions of Parts 264 and 265, Subparts AA and BB, must also comply with the inspection, monitoring, and testing requirements of Sections 264.1034, 265.1034, 264.1063, and 265.1063. Leak detection monitoring is required in Sections 264.1052 to 264.1062 and Sections 265.1052 to 265.1062 for the affected pieces of equipment. This monitoring must be in accordance with Reference Method 21 in 40 CFR Part 60. The detection instrument used to determine if a leak is present shall meet the performance criteria of this method. When checking for a leak, the instrument probe must be traversed around and as close as possible to all potential leak interfaces. The detection instrument shall be calibrated before it is used each day using procedures and gases specified in EPA Reference Method 21.

When equipment is being tested for compliance with no detectable emissions, the test must comply with the leak detection monitoring requirements of Section 264.1063(b) and Section 265.1063(b). In addition, the background level shall be determined as described in Method 21. The arithmetic difference between the maximum organic concentration indicated by the instrument and the background organic concentration level is compared with 500 ppm for determining compliance. If the difference between the two values is greater than 500 ppm, then emissions are detected.

### 7.1.1 Process Vents

A TSDF owner/operator is required by Sections 264.1033 and 265.1033 to monitor and inspect each control device required to comply with the process vent standards (Sections 264.1032 and 265.1032) to ensure proper operation and maintenance. As part of this requirement, the owner/operator is to install, calibrate, operate, and maintain a flow indicator that provides a record of vent stream flow from each affected process vent to the control device at least once every hour. The flow indicator is to be installed as close as possible to the control device inlet, but before being combined with other vent streams.

The owner/operator is also required to install, calibrate, maintain, and operate an appropriate device to monitor the operation of control devices. For vapor incinerators, a temperature monitoring device equipped with a continuous recorder is required. The monitoring device must have an accuracy of ±1 percent of the temperature being monitored in degrees Celsius or ±0.5 °C, whichever is greater. For thermal vapor incinerators, the temperature sensor is to be installed at a location in the combustion chamber downstream from the combustion zone. The monitoring device required for catalytic vapor incinerators must be able to monitor temperature at two locations. These temperature sensors are required to be installed in the vent stream as close as possible to the catalyst bed inlet and outlet.

For flares, a heat-sensing monitoring device equipped with a continuous recorder that demonstrates continuous ignition of the pilot flame is required.

Boilers and process heaters with a design heat input capacity of less than 44 MW are required to have a temperature monitoring device. The device is to have an accuracy of ±1 percent of the temperature being monitored in degrees Celsius or, ±0.5 °C, whichever is greater. The temperature sensor is to be installed at a location in the furnace downstream of the flame zone. Boilers and process heaters with a design heat input capacity greater than or equal to 44 MW are required to be equipped with a monitoring device with a continuous recorder to measure a parameter (e.g., combustion temperature) that demonstrates that good combustion operating practices are being used.

When condensers are used, they are required to be equipped with either a concentration level or temperature monitoring device and a continuous recorder. A concentration monitoring device must be capable of monitoring the concentration level of organic compounds in the condenser exhaust vent stream. A temperature monitoring device must be capable of monitoring temperature at two locations and have an accuracy of ±1 percent of the temperature being monitored in degrees Celsius or, ±0.5 °C, whichever is greater. One of the temperature sensors is required to be installed at a location in the condenser exhaust vent stream, and the second temperature sensor is to be installed at a location in the coolant fluid exiting the condenser.

Carbon adsorption systems that regenerate the carbon bed directly in the control device are required to have a monitoring device with a continuous recorder. The device can either measure the concentration level of the organic compounds in the exhaust vent stream from the carbon bed or measure a parameter that demonstrates that the carbon bed is regenerated on a regular, predetermined time cycle.

Carbon adsorption systems that do not regenerate the carbon bed directly on-site in the control device (e.g., carbon canisters) are required to measure the concentration level of the organic compounds in the exhaust vent stream on a regular schedule. It is also required that the existing carbon be replaced with fresh carbon immediately after breakthrough is indicated. The monitoring frequency is to be at an interval of 20 percent of the time required to consume the total carbon working capacity or once a day, whichever is less frequent. An example illustrating how to calculate carbon canister monitoring frequency is presented in Appendix I.

The monitoring device used to indicate the concentration level of organic compounds exiting a condenser or carbon adsorption system should be based on a detection principle such as infrared detection, photoionization, or thermal conductivity.

The TSDF owner/operator is required to inspect the readings from each of the monitoring devices at least once each operating day to check control device operation and, if necessary, immediately implement the corrective actions necessary to ensure that the control device operates in compliance with Subparts AA and BB.

When a control device other than an incinerator, flare, boiler, process heater, condenser, or carbon adsorption system is used, the owner/operator is required to demonstrate the organic emission reduction achieved by the control device. This demonstration can be made by conducting a performance or source test, by using engineering calculations, or with vendor certification of equipment performance. If owners/operators elect to conduct a performance test, they are required to develop and record a test plan as specified in Sections 264.1035 and 265.1035. An additional requirement when applying for a RCRA permit is that the Regional Administrator be provided with sufficient information to describe the control device operation and indicate the process parameter or parameters that demonstrate proper operation and maintenance of the control device. The Regional Administrator may request additional information and will specify the appropriate monitoring, inspection, and maintenance requirements.

Closed-vent systems must be monitored to show that no detectable emissions are present. This monitoring must be done initially, annually, and at other times as requested by the Regional Administrator. Leaks in closed-vent systems, as indicated by an instrument reading of 500 ppm or greater or by visual inspections, must be repaired as soon as possible, but not later than 15 calendar days after the leak is detected. A first attempt at repair must be made no later than 5 calendar days after the leak is detected.

### 7.1.2 Equipment Leaks

7.1.2.1 Pumps. Each pump in light-liquid service must be monitored for leaks on a monthly basis in accordance with Reference Method 21 in 40 CFR 60. In addition, pumps in light-liquid service must be visually inspected each calendar week for indications of liquid dripping from the pump seal. If an instrument reading of 10,000 ppm or greater is measured or if there are indications of liquid dripping from the pump seal, then a leak is detected. When a leak is detected, it shall be repaired as soon as possible, but not later than 15 calendar days after it is detected. A first attempt at repair must be made no later than 5 days after the leak is detected.

Pumps equipped with a dual mechanical seal system that includes a barrier fluid system are exempt from the above monitoring requirements if each dual mechanical seal system is: (a) operated with a barrier fluid pressure that is at all times greater than the pump stuffing box pressure; (b) equipped with a barrier fluid degassing reservoir that is connected by a closed-vent system to a control device that complies with the requirements of Section 264.1060 or Section 265.1060; or (c) equipped with a system that purges the barrier fluid into a hazardous waste stream with no detectable organic emissions to the atmosphere. (This system must be checked daily or equipped with an audible alarm.) For such a system, the owner/operator must also determine a criterion that indicates failure of the seal system, the barrier fluid system, or both. Additionally, the barrier fluid system must not be a hazardous waste with organic concentrations of 10 percent or greater by weight. Each barrier fluid system must also be equipped with a sensor that will detect failure of the seal system, the barrier fluid system, or both. The sensor must be equipped with an audible alarm that must be checked monthly to ensure that it is functioning properly. Each pump must be visually inspected, each calendar week, for indications of liquid dripping from the pump seals. If liquid is dripping from the pump seal of if the sensor indicates failure, a leak is detected. A first attempt at repair of the leak must be made within 5 calendar days of detection, and repair must be completed not later than 15 calendar days after detection.

Any pump that is designated for no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, is exempt from the weekly and monthly monitoring requirements of Section 264.1052(a) or Section 265.1052(a), the repair requirements of Section 264.1052(c) or 265.1052(c), and the requirements of Section 264.1052(d) or 265.1052(d). For pumps with dual mechanical seal systems, exemption may be granted provided that the pumps: (a) have no externally actuated shaft penetrating the pump housing; (b) operate with no detectable emissions as indicated by an instrument reading of less than 500 ppm above background as measured by the methods specified in Section 264.1063(c) or 265.1063(c); and (c) be visually inspected for indications of liquid dripping from the seal initially upon designation, annually, and at other times as requested by the Regional Administrator.

Any pump that is equipped with a closed-vent system capable of capturing and transporting any leakage from the seal(s) to a control device that complies with the requirements of Section 264.1060 or 265.1060 is exempt from the above requirements for pumps in light-liquid service.

7.1.2.2 Compressors. Compressors are required to be equipped with a seal system that includes a barrier fluid system and prevents leakage of total organic emissions to the atmosphere. Each compressor seal system must be operated with the barrier fluid at a pressure that is greater than the compressor stuffing box pressure, equipped with a barrier fluid system that is connected by a closed-vent system to a control device that complies with Section 264.1060 or Section 265.1060, or equipped with a system that purges the barrier fluid into a hazardous waste stream with zero total organic emissions to the atmosphere. In addition, the barrier fluid must not be a hazardous waste with organic concentrations of 10 percent or greater by weight.

Each barrier fluid system must be equipped with a sensor that will detect failure of the seal system, barrier fluid system, or both. The sensors must be checked daily or equipped with an audible alarm unless the compressor is located within the boundary of an unmanned plant site, in which case the sensor must be checked daily. The audible alarm must be checked monthly to ensure that it is functioning properly. The owner/operator is responsible for determining a criterion that indicates system(s) failure. If a failure occurs, a leak is detected. Repair is then required to be initiated within 5 days and completed within 15 days of detection.

A compressor is exempt from the seal and barrier fluid system requirements described above if it is equipped with a closed-vent system capable of capturing and transporting any leakage from the seal to a control device that complies with the requirements of Section 264.1060 or 265.1060.

Any compressor that is designated for no detectable emissions as indicated by an instrument reading of less than 500 ppm above background is exempt from the above requirements if it is demonstrated to be operating with no detectable emissions, as measured by the method specified in Section 264.1063(c) or 265.1063(c) and is tested initially upon designation, annually, and at other times requested by the Regional Administration to determine that no detectable emissions are present.

7.1.2.3 Pressure Relief Devices. Pressure relief devices in gas/vapor service are required to be operated with no detectable emissions except during pressure releases. No detectable emissions are defined as an instrument reading of less than 500 ppm above background, as measured by the method specified in Section 264.1063(c) or Section 265.1063(c). As soon as possible, but not later than 5 days after each pressure release, the pressure relief device must be returned to a condition of no detectable emissions except as provided in Section 264.1054 or 265.1054. No later than 5 calendar days after the pressure release, the pressure relief device shall be monitored to confirm the conditions of no detectable emissions. Any pressure relief device that is equipped with a closed-vent system capable of capturing and transporting leakage from the pressure relief device to a control device as described in Section 264.1060 or 265.1060 is exempt from the above requirements.

7.1.2.4 Valves. Valves in light-liquid or gas/vapor service must be monitored monthly to detect leaks in accordance with Reference Method 21 in 40 CFR 60. If an instrument reading of 10,000 ppm or greater is measured, a leak is detected. Any valve for which a leak is not detected for 2 successive months may be monitored the first month of every succeeding quarter, beginning with the next quarter, until a leak is detected. If a leak is detected, the valve must be monitored monthly until a leak is not detected for 2 successive months. Repairs must be made as soon as possible and are required to be initiated no later than 5 days after detection and completed no later than 15 calendar days after detection.

Any valve that is designated for no detectable emissions under the provisions of Section 264.1057(f) or 265.1057(f) is exempt from the above monthly monitoring requirements if the valve has no external actuating mechanism in contact with the process fluid; is operated with emissions less than 500 ppm above background; and is tested for compliance with the no detectable emission standards initially upon designation, annually, and at other times as requested by the Regional Administrator.

Any valve that is designated under the provisions of Section 264.1057(g) or 265.1057(g) as unsafe-to-monitor is exempt from the monthly monitoring requirements if the owner/operator demonstrates that the valve is unsafe to monitor because monitoring personnel would be exposed to an immediate danger, and if the owner/operator adheres to a written plan that requires monitoring of the valve as frequently as possible during safe-to-monitor times.

Valves designated under the provisions of Section 264.1057(h) or 265.1057(h) as difficult-to-monitor are exempt from the monthly monitoring requirements if (a) the owner/operator demonstrates that the valve cannot be monitored without elevating the monitoring personnel more than 2 m (6.6 ft) above a support surface, (b) the hazardous waste management unit that the valve is a part of is located in an existing hazardous waste management unit, and (c) the owner/operator follows a written plan that requires monitoring of the valve at least once per calendar year.

An owner/operator subject to the above requirements for valves in gas/vapor or light-liquid service may elect to have all valves within a hazardous waste management unit comply with an alternative standard that allows no greater than 2 percent of the valves to leak. If this alternative standard is chosen, the owner/operator must notify the Regional Administrator. A performance test must also be conducted initially upon designation, annually, and at other times requested by the Regional Administrator. The performance test requires all valves in the hazardous waste management unit subject to the requirements in Section 264.1061 or 265.1061 to be monitored within 1 week by the methods specified in Section 264.1063(b) or Section 265.1063(b). If an instrument reading of 10,000 ppm or greater is measured, a leak is detected. If a leak is detected, it shall be repaired in accordance with Section 264.1057(d) and (e) or Section 265.1057(d) and (e). The leak percentage is determined by dividing the number of leaking valves subject to the requirements in Section 264.1057 or 265.1057 by the total number of valves that are subject to the requirements in Section 264.1057 or Section 265.1057 within the hazardous waste management unit.

If an owner/operator decides to no longer comply with the alternative standards for valves (Section 264.1061 or 265.1061), the Regional Administrator must be notified in writing that the standard described in Sections 264.1057(a) through (e) or Sections 265.1057(a) through (e) will be followed.

Additional alternative standards for valves in gas/vapor or light-liquid service may be elected by owners/operators subject to the requirements of Section 264.1057 or 265.1057. These alternative work practices require the owner/operator to comply with the valve monitoring as described in Section 264.1057 or 265.1057. However, if after two consecutive quarterly leak detection periods when the percentage of valves leaking is equal to or less than 2 percent, an owner/operator may begin to skip one of the quarterly leak detection periods; or, if after five consecutive quarterly leak detection periods when the percentage of valves leaking is equal to or less than 2 percent, an owner/operator may begin to skip three of the quarterly leak detection periods. If the percentage of valves leaking is greater than 2 percent, the owner/operator must monitor monthly in compliance with Section 264.1057 or 265.1057, but may again elect to use this alternative standard (Section 264.1062 or 265.1062) after meeting the requirements of Section 264.1057(c)(1) or 265.1057(c)(1). The owner/operator must notify the Regional Administrator before implementing one of the alternative work practices.

7.1.2.5 Other Equipment. Pumps and valves in heavy-liquid service, pressure relief devices in light-liquid or heavy-liquid service, and flanges and other connectors shall be monitored within 5 days by the method specified in Section 264.1063(b) or 265.1063(b) if evidence of a potential leak is found by visual, audible, olfactory, or any other detection method. If an instrument reading of 10,000 ppm or greater is measured, a leak is detected. After a leak is detected, the first attempt at repair must be made within 5 calendar days and the repair must be completed within 15 calendar days. First attempts at repairs include, but are not limited to, the practices described in Section 264.1057(e) or 265.1057(e).

## 7.2 RECORDKEEPING

Each TSDF owner/operator subject to the provisions of Subparts AA and/or BB must comply with the recordkeeping requirements of Sections 264.1035, 264.1064, 265.1035 or 265.1034. An owner/operator of more than one facility subject to these requirements may comply with the recordkeeping requirements for these hazardous waste management units with one recordkeeping system if the system identifies each record by each hazardous waste management unit.

Table 7-1 summarizes the recordkeeping and reporting requirements of the process vent and equipment leak air emission standards. The following sections outline the general RCRA recordkeeping requirements and the specific recordkeeping requirements of the process vent and equipment leak air emission standards.

### 7.2.1 General RCRA Recordkeeping Requirements

The general RCRA recordkeeping requirements for permitted and interim-status facilities are contained in 40 CFR 264, Subpart E, and 40 CFR 265,

## TABLE 7-1. CROSS-REFERENCE BETWEEN SUBSTANTIVE REQUIREMENTS AND RECORDKEEPING/REPORTING REQUIREMENTS OF PARTS 264 AND 265, SUBPARTS AA[a] and BB

| Item[b,c] | Substantive requirement[d] | Recordkeeping/reporting requirement |
|---|---|---|
| A. Pumps in light-liquid service | 1. Monthly LDRP[e] §264.1052 and §265.1052. | 3. Tag leaking sources only - §264.1064(c) and §265.1064(c). |
| | 2. Weekly visual inspection[f] §264.1052(a)(2) and §265.1052(a)(2). | 4. Record dates, repair attempts and methods, and reasons for delay of repair etc. - §264.1064(d) and §265.1064(d). |
| B. Pumps in light-liquid service (Dual seal systems)[c] | 1. Designed and operated under certain conditions[g] §264.1052(d)(1)-(6) and §265.1052(d)(1)-(6). | 3. Record seal system design criterion - §264.1064(j) and §265.1064(j). |
| | 2. Inspection of seals and seal systems-§264.1052(d)(4),(5),(6) and §265.1052(d)(4),(5),(6). | 4. Same as A3 and A4. |
| C. Pumps in light-liquid service (Sealless)[c] | 1. Designed and operated under certain conditions - §264.1052(e)(1),(2) and §265.1052(e)(1),(2). | 3. Record results of compliance tests - §264.1064(g) and §265.1064(g). |
| | 2. Tested for "no detectable emissions" - §264.1052(e)(3) and §265.1052(e)(3). | |
| D. Pumps in light-liquid service (Hooded)[c] | 1. Designed and operated under certain conditions - §264.1052(f) and §265.1052(f). | 2. Record design criterion - §264.1064(e) and §265.1064(e) |
| E. Compressors (General) | 1. Installation of seal system §264.1053(a)-(d) and §265.1053(a)-(d). | 3. Record seal system design criterion - §264.1064(j) and §265.1064(j). |
| | 2. Inspection of seals - §264.1053(e) and §265.1053(e). | 4. Same as A3, A4. |

(continued)

TABLE 7-1 (continued)

| Item[b,c] | Substantive requirement[d] | Recordkeeping/reporting requirement |
|---|---|---|
| F. Compressors (Hooded)[c] | 1. Designed and operated under certain conditions - §264.1053(h) and §265.1053(h). | 2. Same as D2. |
| G. Compressors (Sealless)[c] | 1. Designed and operated under certain conditions - §264.1053(i)(1) and §265.1053(i)(1). | 3. Same as C3. |
| | 2. Tested for "no detectable emissions - §264.1053(i)(2) and §265.1053(i)(2). | |
| H. Pressure relief devices (gas service) (General) | 1. Designed and operated for no detectable emissions - §264.1054(a) and §265.1054(a). | 3. Same as C3. |
| | 2. Tested for no detectable emissions - §264.1054(b) and §265.1054(b). | |
| I. Pressure relief devices (gas service) (Hooded)[c] | 1. Designed and operated under certain conditions - §264.1054(c) and §265.1054(c). | 2. Same as D2. |
| J. Sampling connection systems (General) | 1. Designed and operated under certain conditions - §264.1055(a),(b) and §265.1055(a),(b). | 2. Same as D2. |
| K. Open-ended valves or lines | 1. Cap open-ended lines §264.1056(a)(1) and §265.1056(a)(1). | |
| | 2. Operational requirements §264.1056(a)(2),(b),(c) and §265.1056(a)(2),(b),(c). | |
| L. Valves in gas/vapor service in light-liquid service | 1. Monthly LDRP - §264.1057 (a)-(e) and §265.1057(a)-(e). | 2. Same as A3, A4. |

(continued)

TABLE 7-1 (continued)

| Item[b,c] | | Substantive requirement[d] | | Recordkeeping/reporting requirement | |
|---|---|---|---|---|---|
| M. | Valves in gas/vapor service in light-liquid service (Leakless)[c] | 1. | Designed and operated under certain conditions - §264.1057(f)(1) and (2) and §265.1057(f)(1) and (2). | 3. | Same as C3. |
| | | 2. | Tested for "no detectable emissions" - §264.1057(f)(3) and §265.1057(f)(3). | | |
| N. | Valves in gas/vapor service in light-liquid service (Unsafe to monitor) | 1. | Monitoring during safe-to-monitor times - §264.1057 (g)(2) and §265.1057(g)(2). | 2. | Maintain record of monitoring plan and explain why valve is unsafe to monitor- §264.1064(h)(1) and §265.1064(h)(1). |
| O. | Valves in gas/vapor service in light-liquid service (Difficult to monitor) | 1. | Annual monitoring - §264.1057(h)(3) and §265.1057(h)(3). | 2. | Maintain record of monitoring schedule and explain why valve is difficult to monitor - §264.1064 (h)(2) and §265.1064 (h)(2). |
| P. | Pumps and valves in heavy-liquid service | 1. | LDRP within 5 days - §264.1058(a) and §265.1058(a). | 2. | Record heavy liquid service determination - §264.1064(k)(2) and §265.1064(k)(2). |
| | | | | 3. | Same as A3, A4. |
| Q. | Pressure relief devices in liquid service and flanges and other connectors (General) | 1. | LDRP within 5 days §264.1058(a) and §265.1058(a). | 2. | Same as A3, A4. |
| R. | Delay of repair (General) | 1. | Repair infeasible without unit shutdown - §264.1059(a) and 265.1059(a) | 2. | Record reason for delay repair, owner/operator signature, expected date of repair, dates of shutdowns - §264.1064(d)(6)-(9) and §265.1064(d)(6)-(9). |

(continued)

TABLE 7-1 (continued)

| Item[b,c] | | Substantive requirement[d] | Recordkeeping/reporting requirement |
|---|---|---|---|
| S. | Delay of repair (Out of service) | 1. Equipment isolated from process and not in service - §264.1059(b) and §265.1059(b). | 2. Same as R2. |
| T. | Delay of repair (Valves) | 1. Purged emissions greater than emissions from delay - §264.1059(c) and §265.1059(c). | 3. Same as R2. |
| | | 2. Beyond shutdown if stock of valve bodies is depleted - §264.1059(e) and §265.1059(e). | |
| U. | Delay of repair (Pumps) | 1. If dual seal/barrier fluid system is used - §264.1059 (d) and §265.1059(d). | 2. Same as R2. |
| V. | Closed-vent systems and control devices (General) | 1. Designed and operated under certain conditions - §264.1033, §264.1060, §265.1033 and §265.1060. | 4. Same as D2.<br>5. Same as C3. |
| | | 2. Tested for "no detectable emissions" - §264.1033(j)(2) and §265.1033(j)(2). | 6. Report exceedances semiannually - §264.1036(a)(2), §264.1065(a)(4), §265.1036(a)(2), and §265.1065(a)(4). |
| | | 3. Operate closed-vent systems and control devices when emissions are vented to them - §264.1033(k) and §265.1033(k). | |
| W. | Closed-vent systems and control devices (Vapor recovery) | 1. Designed and operated under certain conditions - §264.1033(b) and §265.1033(b). | 4. Same as D2.<br>5. Record exceedances - §264.1035(c)(3)(vi), (vii),(viii),(ix), §265.1035(c)(3)(vi), (vii),(viii),(ix), §264.1064(e), and §265.1064(e). |
| | | 2. Monitor control devices - §264.1033(f),(g),(h) and §265.1033(f),(g)(h). | |
| | | 3. Same as V3. | |
| X. | Closed-vent systems and control devices (Enclosed combustion) | 1. Designed and operated under certain conditions - §264.1033(c) and §265.1033(c). | 4. Same as D2. |

(continued)

TABLE 7-1 (continued)

| Item[b,c] | Substantive requirement[d] | Recordkeeping/reporting requirement |
|---|---|---|
| X. (con.) | 2. Monitor control devices - §264.1033(f) and §265.1033(f). | 5. Record exceedances - §264.1035(c)(3)(i),(ii),(iii),(iv) and §265.1035(c)(3)(i),(ii),(iii),(iv). |
| | 3. Same as V3. | |
| Y. Closed-vent systems and control devices (Flares) | 1. Designed and operated under certain conditions - §264.1033(d)(1)-(6) and §265.1033(d)(1)-(6). | 4. Same D2. |
| | 2. Monitor control devices - §264.1033(f) and §265.1033(f). | 5. Record exceedances - §264.1035(c)(3)(v) and §265.1035(c)(3)(v). |
| | 3. Same as V3. | |
| Z. Alternative standards for valves (allowable percent leaking)[c] | 1. Elect to follow alternative and notify Regional Administrator - §264.1061(a),(b)(1), and §265.1061(a),(b)(1). | 3. Notify if return to routine work practice - §264.1061(d) and §265.1061(d). |
| | 2. Conduct performance test - §264.1061(b)(2),(c)(1)-(3) and §265.1061(b)(2),(c)(1)-(3). | |
| AA. Alternative standards for Valves (skip period LDRP)[c] | 1. Elect to follow one or two alternative work practices and notify Regional Administrator - §264.1062(a) and §265.1062(a). | 5. Record monitoring schedule and percent of valves leaking - §264.1064(i) and §265.1064(i). |
| | 2. Comply initially with routine valves standard - §264.1062(b)(1) and §265.1062(b)(1). | |
| | 3. Follow one or two alternative work practices - §264.1062(b)(2)-(3) and §265.1062(b)(2)-(3). | |
| | 4. Return to routine valve standard if 2 percent valves leaking is exceeded - §264.1062(b)(4) and §265.1062(b)(4). | |

(continued)

TABLE 7-1 (continued)

| Item[b,c] | Substantive requirement[d] | Recordkeeping/reporting requirement |
|---|---|---|
| AB. Process vents | 1. Comply with facility emission limit or reduce organic emissions from all affected process vents - §264.1032 and §265.1032. | |
| | 2. Control device designed and operated under certain conditions - §264.1033 and §265.1033. | 4. Same as D2. |
| | 3. Monitor control device parameters - Same as W2, X2, Y2. | 5. Same as W5, X5, Y5. |
| | | 6. Same as V6. |

[a] The requirements presented in this table are those for the process vents and equipment covered by Subparts AA and BB.

[b] Each source covered by Subparts AA and BB is listed and the requirements for that source are annotated mainly by indicating the substantive requirements for that source, the citation for those requirements, the associated recordkeeping/reporting requirements and their citation. Each block (e.g., 'A. Pumps (General)') is mutally exclusive of other blocks.

[c] A note 'c' indicates that the requirements are alternatives to the general requirements. As such, these requirements take the place of the general requirements. Accordingly, if a piece of equipment is covered by an alternative requirement, it is not covered by the general requirements.

[d] The substantive requirements are summarized and a reference to the exact regulatory language is provided if more detail is needed.

[e] LDRP means "leak detection and repair program." This generally includes the use of a portable monitor to detect leaks and then, for those pieces of equipment that are leaking, repair of the leak. Delay of repair is general to all sources and is presented separately.

[f] Inspection generally means visual inspection of seal areas as well as seal-barrier fluid system integrity. Inspection includes repair of leaking seals and seal/barrier fluid systems.

[g] Designed and operated generally means that specific equipment or designs are allowed if they are used in ways that result in emission reductions that are at least equivalent to the general requirements.

Subpart E. These subparts contain discussions on the use of a waste manifest system (Sections 264.71 and 265.71), requirements for facility operating records (Sections 264.73 and 265.73), availability of records (Sections 264.74 and 265.74), and the facility biennial report (Sections 264.75 and 265.75). Information (with the exception of the results of inspections) must be maintained in the operating record until facility closure. In addition to submitting the biennial reports and unmanifested waste reports, the owner/ operator is required to report to the Regional Administrator specific occurrences as outlined in Sections 264.77(a)-(c) and 265.77(a)-(c).

### 7.2.2 Process Vent Recordkeeping Requirements

For each process vent to which Subpart AA of Part 264 or 265 applies, the owner/operator must record in the facility operating record: identification number and hazardous waste management unit identification, type of unit, percent by weight total organics in the hazardous waste managed in the unit, state (e.g., gas/vapor or liquid) of hazardous waste at the unit, the organic emissions from each process vent associated with the unit, and method of compliance with the standard.

The facility operating record must also include an implementation schedule indicating dates by which the design and construction of any control device and closed-vent systems required by the provisions of Section 264.1032 or 265.1032 will be completed. The implementation schedule may allow up to 18 months after the effective date for completing engineering design and evaluation studies and for installation of controls. The final standards require that both permitted and interim-status facilities maintain the schedules and the accompanying documentation in their operating records. The implementation schedule must be in the operating record on the effective date of the regulation, which is 6 months after promulgation. No provisions have been made in the standards for extensions beyond the 18-month allowance.

Included in the facility operating record must be documentation that demonstrates compliance with the process vent standards in Section 264.1032 or 265.1032. This documentation must include information and data identifying all affected process vents, annual facility throughput, annual facility operating hours, estimated emission rates for each affected vent and for the overall facility, and information and data supporting estimates of vent emissions and emission reductions achieved by add-on control devices based on engineering calculations or source tests. Also included in the operating record must be documentation that demonstrates compliance with the equipment standards in Sections 264.1052 to 264.1062 or Sections 265.1052 to 265.1062. The Regional Administrator may request further documentation before deciding if compliance has been demonstrated.

Documentation to demonstrate compliance with Section 264.1033 or 265.1033, must include a list of all information, references, and sources used in preparing the documentation; records required by Section 264.1035(b) or 265.1035(b) that document the organic content of the liquids, gases, or fumes emitted to the atmosphere; a design analysis based on the appropriate sections of "Control of Gaseous Air Pollutants" or other engineering texts; a statement signed and dated by the owner/operator certifying that the operating parameters used in the design analysis represent the conditions that exist when the hazardous waste management unit is operating at the highest load or capacity level reasonably expected to occur; and a signed and dated statement by the owner/operator certifying that the control device is designed to operate at 95 or greater percent efficiency unless the total organic emission limits of Section 264.1032 and 265.1032 for affected process vents at the facility can be attained by a control device involving vapor recovery at an efficiency less than 95 percent.

The facility's process vent emission rate determination must be appropriate at all times to the facility's current waste management unit designs and wastes managed. If the owner/operator takes any action that would result in the determination no longer being appropriate to the facility's operations, then a new determination is required (e.g., if a waste of different composition is managed, the operating hours of the affected management units are increased beyond what was originally considered, or a new affected unit is added).

Design and operating information for each closed-vent system and control device required by Sections 264.1032 and 265.1032 shall be recorded and kept up-to-date in the facility operating record. The operating information described in (d) and (e) below need only be kept for 3 years. The required design and operating information includes: (a) detailed design specifications, drawings, schematics, and piping and instrumentation diagrams; (b) description and date of each modification that is made to the closed-vent system or control device design; (c) identification of operating parameter, description of monitoring device, and a diagram of monitoring sensor location(s) used to comply with Section 265.1033(f)(2); (d) date, time, and duration of each period when any monitored parameter identified above exceeds the value established in the control device design analysis, as well as an explanation of the cause for the exceedance and the measures implemented to correct the control device operation; and (e) the date of each control device startup or shutdown.

For thermal vapor incinerators designed to operate with a minimum residence time of 0.50 s at a minimum temperature of 760 °C (1,400 °F), the above information must be recorded for periods when the combustion temperature is below 760 °C (1,400 °F). For thermal vapor incinerators designed to operate with an organic emission reduction efficiency of 95 percent or greater, the owner/operator is required to record the period when the combustion temperature is more than 28 °C (82.4 °F) below the design average combustion temperature established as a requirement of Section 264.1035(b)(4)(iii)(A) or 265.1035(b)(4)(iii)(A).

TSDF owner/operators with catalytic incinerators are required to record the period when the temperature of the vent stream at the catalyst bed inlet is more than 28 °C (82.4 °F) below the average temperature of the vent stream or the temperature difference across the catalyst bed is less than 80 percent of the design average temperature difference established as a requirement of Section 264.1035(b)(4)(iii)(B) or 265.1035(b)(4)(iii)(B).

For boilers or process heaters, the owner/operator is required to record periods when the combustion temperature is more than 28 °C (82.4 °F) below the design average combustion temperature or, when position changes where the vent stream is introduced to the flame zone as a requirement of Section 264.1035(b)(4)(iii)(C) or 265.1035(b)(4)(iii)(C). When flares are used, the owner/operator must record periods when the pilot flame is not ignited.

TSDF owner/operators that have condensers with a monitoring device equipped with a continuous recorder, must record the period when the organic compound concentration in the exhaust vent stream is more than 20 percent greater than the design level established as a requirement of Section 264.1035(b)(4)(iii)(E) or 265.1035(b)(4)(iii)(E). For condensers that comply with Section 264.1033(f)(2)(vi)(B) or 265.1033(f)(2)(vi)(B), the owner/ operator is required to record the period when the temperature of the exhaust vent stream is more than 6 °C (42.8 °F) above the design average exhaust vent stream temperature established as a requirement of Section 264.1035(b)(4)(iii)(E) or 265.1035(b)(4)(iii)(E) or the period when the temperature of the coolant fluid exiting the condenser is more than 6 °C (42.8 °F) above the design average coolant fluid temperature established as a requirement of Section 264.1035(b)(4)(iii)(E) or 265.1036(b)(4)(iii)(E).

For carbon adsorption systems that regenerate the carbon bed directly on site in the control device and comply with Section 264.1033(f)(2)(vii)(A) or 265.1033(f)(2)(vii)(A), the owner/operator is required to record any periods when the organic compound concentration level or reading of organic compounds in the exhaust vent stream is more than 20 percent greater than the design exhaust vent stream organic compound concentration level established as a requirement of Section 264.1035(b)(4)(iii)(E) or 265.1035(b)(4)(iii)(F). For similar types of carbon adsorption systems that comply with Section 264.1033(f)(2)(vii)(B) or 265.1033(f)(2)(vii)(B), it is required that the owner/operator record any periods when the vent stream continues to flow through the control device beyond the predetermined carbon bed regeneration time established as a requirement of Section 264.1035(b)(4)(iii)(F) or 265.1035(b)(4)(iii)(F).

Additional requirements for carbon adsorption systems are that those systems operated subject to the requirements of Section 264.1033(g), 265.1033(g), 264.1033(h)(2), or 265.1033(h)(2) must record the date when existing carbon in the control device is replaced with fresh carbon. For carbon adsorption systems operated subject to the requirements specified in Section 264.1033(h)(1) or 265.1033(h)(1), the owner/operator is required to maintain a log that records the date and time when the control device is monitored for carbon breakthrough, the monitoring device reading, and the date when existing carbon in the control device is replaced with fresh carbon.

When either carbon regeneration or removal takes place, there is an opportunity for organics to be released to the atmosphere unless the carbon removal or regeneration is carried out under controlled conditions. There would be no environmental benefit in removing organics from an exhaust gas stream using adsorption onto activated carbon if the organics are subsequently released to the atmosphere during desorption or during carbon disposal. The EPA therefore expects that owners or operators of TSDF using carbon adsorption systems to control organic emissions take steps to ensure that proper emission control of regenerated or disposed carbon occurs. For on-site regenerable carbon adsorption systems, the owner or operator must account for the emission control of the desorption and/or disposal process in the control efficiency determination. In the case of off-site regeneration or disposal, the owner or operator should supply a certification, to be placed in the operating file of the TSDF, that all carbon removed from a carbon adsorption system used to comply with Subparts AA and BB is either: (1) regenerated or reactivated by a process that prevents the release of organics to the atmosphere (Note: The EPA interprets "prevents" as used in this paragraph to include the application of effective control devices such as those required by these rules), (2) incinerated in a device that meets the performance standards of Subpart O, or (3) disposed in compliance with Federal and State regulations.

For control devices other than thermal or catalytic incinerators, flares, boilers, process heaters, condensers, or carbon adsorption systems, owners/operators of interim status facilities must record information indicating proper operation and maintenance of the control device in the facility operating record. The Regional Administrator (or Director) will specify the appropriate recordkeeping requirements for facilities with final permits as a part of the permit negotiation process.

### 7.2.3 Equipment Leak Recordkeeping Requirements

Information pertaining to equipment subject to the requirements in Parts 264 and 265, Subpart BB, must be recorded in a log that is kept in the facility operating record. This information includes:

1. Equipment identification number and hazardous waste management unit identification,
2. Approximate locations within the facility (e.g., identify the hazardous waste management unit on a facility plot plan),
3. Type of equipment (e.g., a pump or pipeline valve),
4. Percent-by-weight total organics in the hazardous waste stream at the equipment,

5. Hazardous waste state at the equipment (e.g., gas/vapor or liquid), and

6. Method of compliance with the standard (e.g., "monthly leak detection and repair" or "equipped with dual mechanical seals").

In addition, for a facility that takes up to 18 months after the effective date to install a closed-vent system and control device, an implementation schedule must be in the operating log. If the owner or operator demonstrates the control device effectiveness with a performance test, the performance test plan and test results must be in the log. Otherwise, detailed design documentation supporting the control device effectiveness must be in the operating log. The log also must contain the monitoring, operating, and inspection information required by the standards.

To help identify equipment not subject to monthly LDAR, the following information is recorded in a log that is kept in the facility operating record:

1. A list of identification numbers for equipment (except welded fittings) subject to the requirements of Subpart BB;

2. A list of identification numbers and signed (by the owner/operator) designations for equipment that the owner/operator elects to designate for no detectable emissions;

3. A list of equipment identification numbers for pressure relief devices;

4. The date of, measured background level, and maximum instrument reading measured at the equipment during each compliance test; and

5. A list of identification numbers of equipment in vacuum service.

Information pertaining to valves subject to the requirements of Sections 264.1057(g) and (h) or 265.1057(g) and (h) must be recorded in a logbook that is kept in the facility operating record. This information includes: a list of identification numbers for valves that are designated as unsafe or difficult to monitor; an explanation for each valve stating why it is unsafe or difficult to monitor; and the plan for monitoring each valve. For valves complying with Section 264.1062 or 265.1062, a schedule of monitoring and the percent of valves found leaking during each monitoring period is required to be recorded in the facility operating record.

When each leak is detected (as specified in Sections 264.1052, 264.1053, 264.1057, and 264.1058 or Sections 256.1052, 265.1053, 265.1057, and 265.1058), a weatherproof and readily visible identification, marked with the equipment identification number, must be attached to the leaking equipment. The identification on a valve may be removed after it has been monitored for 2 successive months and no leak is detected during this time. The identification on equipment, except a valve, may be removed after it has been repaired.

When a leak is detected as specified in the above paragraph, specific information must be recorded in an inspection log and kept in the facility operating record. This includes the instrument, operator, and equipment identification numbers; the date that the leak was detected and the dates of attempted repairs; attempted repair methods; the statement "above 10,000" if the maximum instrument reading measured by the methods specified in Section 264.1063(b) or 265.1063(b) after each repair attempt is equal to or greater than 10,000 ppm; the statement "repair delayed" and the reason for the delay if the repair is not made within 15 calendar days after discovery of the leak; the signature of the owner/operator whose decision it was that the repair could not be effected without a hazardous waste management unit shutdown; the expected date of successful repair of the leak if the leak is not repaired within 15 calender days; and the date of the successful repair of the leak.

Criteria for barrier fluid system sensors required in Sections 264.1052(d)(5) and 264.1053(e)(2) or Sections 265.1052(d)(5) and 265.1053(e)(2), an explanation of the criteria, any changes to the criteria, and reasons for the changes must be recorded in a log that is kept in the facility operating record.

Information used for determining exemptions as provided in the applicability section of this subpart or other specific subparts must be recorded in the log kept in the facility operating record. This information includes: (a) an analysis demonstrating the design capacity of the hazardous waste management unit; (b) a statement listing the hazardous waste influent and effluent from each hazardous waste management unit subject to the requirements in Sections 264.1051-1060 or Sections 265.1051-1060 and an analysis demonstrating whether these hazardous wastes are heavy liquids; and (c) an analysis demonstrating that equipment is not subject to the requirements in Sections 264.1051-1060 or Sections 265.1051-1060.

Information and data that are used to identify and demonstrate that a piece of equipment is not subject to the requirements in Sections 264.1052-1060 or Sections 265.1052-1060 shall be recorded in a log that is kept in the facility operating record.

Records of monthly equipment leak monitoring and repair, detectable emission monitoring, and closed vent system and control device operating information need be kept only 3 years.

The owner/operator of any facility subject to this subpart and to regulations in 40 CFR Part 60, Subpart VV, or 40 CFR Part 61, Subpart V, may elect to demonstrate compliance with the regulations by documentation in accordance with Section 264.1064 or 265.1064 of this subpart or pursuant to provisions of 40 CFR Part 60 or 61 (Section 264.1064(1) or 265.1064(1). For cases when the documentation requirements of 40 CFR Part 60 or 61 duplicate the documentation required under this subpart, multiple copies of identical records are not required. In these instances, the documentation under the regulation in 40 CFR Part 60 or 61 shall be kept with or made readily available with the facility operating record.

## 7.3 REPORTING REQUIREMENTS

The standards for process vents and equipment leaks for RCRA-permitted facilities subject to the provisions of 40 CFR Part 264, Subparts AA and/or BB, require that control device exceedances (i.e., periods when monitoring indicates that operating parameters exceed established tolerances for design specifications) that go uncorrected for more than 24 hours be reported to the Regional Administrator on a semiannual basis. (See Section 7.2.2 for a discussion of control device exceedances.) The reports must include the dates, duration, cause, and corrective measures taken. For equipment leaks, a report is required if a leak is not repaired within the designated time period. If a facility does not have any exceedances during the reporting period, no report is required. There are no reporting requirements for interim status facilities subject to these air rules.

# 8.0 IMPLEMENTATION AND COMPLIANCE

## 8.1 STATE AUTHORIZATION

### 8.1.1 Applicability of Rules in Authorized States

Under Section 3006 of RCRA, EPA may authorize qualified States to administer and enforce the RCRA program within the State. (See 40 CFR Part 271 for the standards and requirements for authorization.) Following authorization, EPA retains enforcement authority under Sections 3008, 7003, and 3013 of RCRA, although authorized States have primary enforcement responsibility under Section 7002.

Prior to the HSWA of 1984, a State with final authorization administered its hazardous waste program entirely in lieu of EPA administering the Federal program in that State. The Federal requirements no longer applied in the authorized State, and EPA could not issue permits for any facilities in the State that the State was authorized to permit. When new, more stringent Federal requirements were promulgated or enacted, the State was obliged to enact equivalent authority within specified timeframes. New Federal requirements did not take effect in an authorized State until the State adopted the requirements as State law.

In contrast, under Section 3006(g)(1) of RCRA, 42 U.S.C. 6926(g), new requirements and prohibitions imposed by HSWA take effect in authorized States at the same time that they take effect in nonauthorized States. The EPA is directed to carry out those requirements and prohibitions in authorized States, including the issuance of permits, until the State is granted authorization to do so. While States must still adopt HSWA-related provisions as State law to retain final authorization, the HSWA requirements apply in authorized States in the interim.

### 8.1.2 Effect on State Authorizations

The Subpart AA and BB rules are promulgated pursuant to Section 3004(n) of RCRA, a provision added by HSWA. Therefore, EPA has added the requirements to Table 1 in 40 CFR 271.1(j), which identifies the Federal program requirements that are promulgated pursuant to HSWA and take effect in all States, regardless of authorization status. States may apply for either interim or final authorization for the HSWA provisions identified in 40 CFR 271.1(j).

The EPA will implement the process vent and equipment leak rules in authorized States until (1) they modify their programs to adopt these rules and receive final authorization for the modification or (2) they receive interim authorization as described below. Because these rules are promulgated pursuant to HSWA, a State submitting a program modification may apply to receive either interim or final authorization under Section 3006(g)(2) or Section 3006(b), respectively, on the basis of requirements that are substantially equivalent or equivalent to EPA's. The procedures and schedule for State program modifications for either interim or final authorization are described in 40 CFR 271.21. It should be noted that all HSWA interim authorizations will expire automatically on January 1, 1993 (see 40 CFR 271.24(c)).

Section 271.21(e)(2) requires that authorized States must modify their programs to reflect Federal program changes and must subsequently submit the modifications to EPA for approval. The deadline for State program modifications for this rule is July 1, 1991 (or July 1, 1992, if a State statutory change is needed). These deadlines can be extended in certain cases [40 CFR 271.21(e)(3)]. Once EPA approves the modification, the State requirements become Subtitle C RCRA requirements.

A State that submits its official application for final authorization less than 12 months after the effective date of these standards is not required to include standards equivalent to these standards in its application. However, the State must modify its program by the deadlines set forth in 40 CFR 271.21(e). States that submit official applications for final authorization 12 months after the effective date of the process vent and equipment leak standards must include standards equivalent to these standards in their applications. Section 271.3 sets forth the requirements a State must meet when submitting its final authorization application.

States that are authorized for RCRA may already have requirements under State law similar to those in the process vent and equipment leak rules. These State regulations must be assessed against the Federal regulations (i.e., Subparts AA and BB) to determine whether they meet the tests for authorization. Thus, a State is not authorized to implement these requirements in lieu of EPA until the State program modification is approved. Of course, States with existing standards may continue to administer and enforce their standards as a matter of State law. In implementing the Federal program, EPA will work with States under cooperative agreements to minimize duplication of efforts. In many cases, EPA will be able to defer to the States in their efforts to implement their programs rather than take separate actions under Federal authority.

## 8.2 IMPLEMENTATION (THE RCRA PERMITTING PROCESS)

The final process vent and equipment leak standards limit organic emissions at new and existing hazardous waste TSDF that need authorization to operate under RCRA Section 3005 and are required to have a permit under RCRA, 40 CFR Part 270. This applicability includes all hazardous waste management units that require RCRA permits and hazardous waste recycling units that are located on hazardous waste management facilities, if a RCRA permit is needed for another part of the facility's operations independent of the process vent and equipment leak rules (i.e., Subparts AA and BB of Parts 264 and 265).

Implementation of these air rules is through incorporation of the rules into the existing RCRA permitting process. The applicability of these standards with respect to their incorporation into the RCRA permitting process is discussed below. Figure 8-1 presents a flow diagram of the RCRA permitting process. Chapter 3.0 of this document presents a flow diagram and several examples that may be used as an aid to determining applicability.

### 8.2.1 Facilities with Permits

Facilities are not required to reopen their permits as a result of the process vent and equipment leak standards. Under the current RCRA permitting system, a facility that has received a final permit must comply with all of the following requirements as specified in 40 CFR 270.4: (1) the specific conditions written into the permit (including conditions that

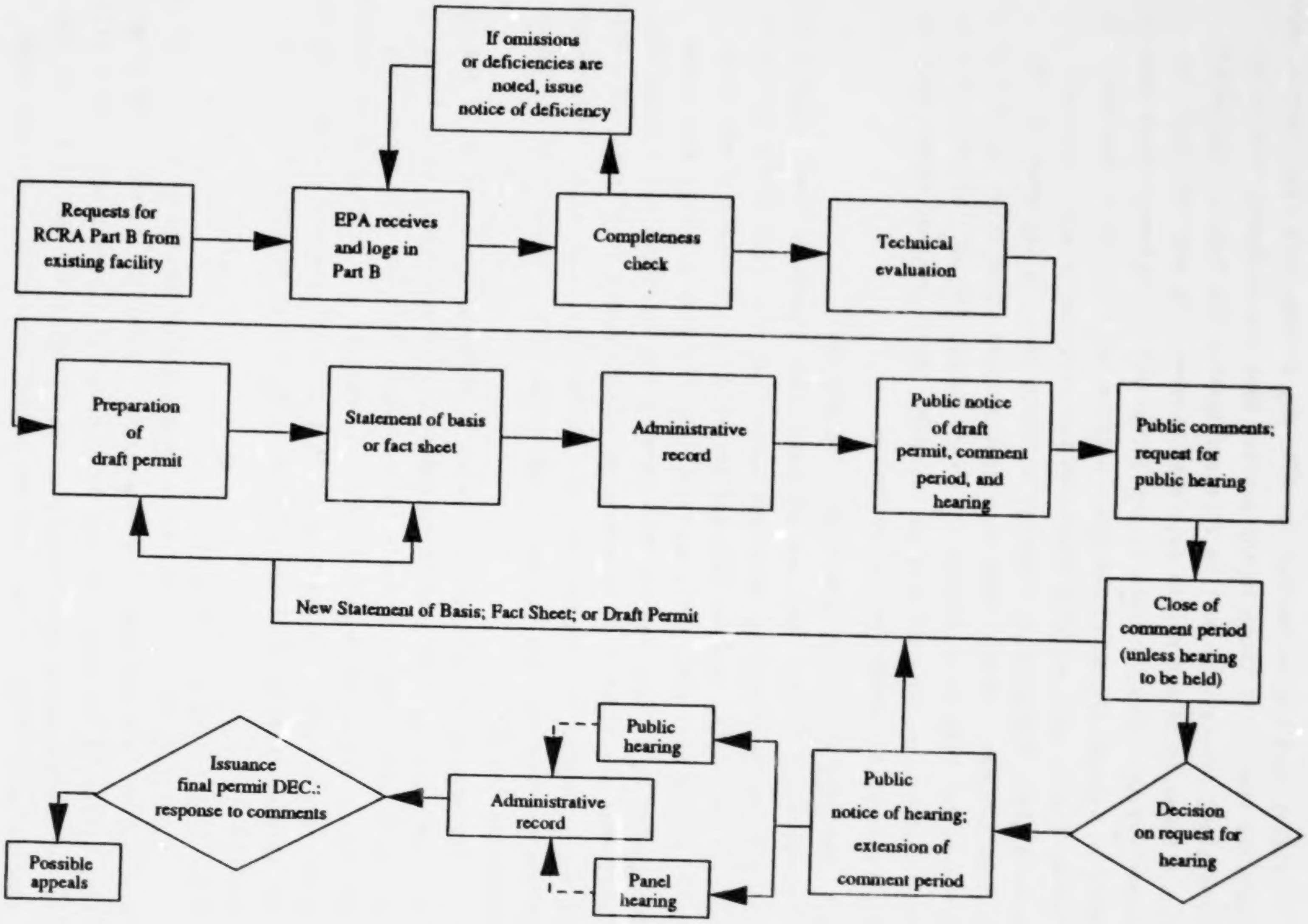
Requests for RCRA Part B from existing facility
EPA receives and logs in Part B
If omissions or deficiencies are noted, issue notice of deficiency
Completeness check
Technical evaluation
Preparation of draft permit
Statement of basis or fact sheet
Administrative record
Public notice of draft permit, comment period, and hearing
Public comments; request for public hearing
Close of comment period (unless hearing to be held)
New Statement of Basis; Fact Sheet; or Draft Permit
Decision on request for hearing
Public notice of hearing; extension of comment period
Public hearing
Panel hearing
Administrative record
Issuance final permit DEC.: response to comments
Possible appeals

Figure 8-1. Flow diagram of the EPA's RCRA permitting process.

demonstrate compliance with Part 264 regulations); (2) self-implementing statutory requirements; and (3) regulations promulgated under 40 CFR Part 268 restricting the placement of hazardous waste in or on the land. When new regulations are promulgated after the issuance of a permit, EPA may reopen the permit to incorporate the new requirements as stated in Section 270.41. Otherwise, the new regulatory requirements are incorporated into a facility's permit at the time of permit reissuance (Section 124.15), or at the 5-year review (Section 270.50) for land disposal facilities.

Although EPA has the authority to reopen permits to incorporate the requirements of new standards, it is concerned about the resource burdens of this approach. To reopen permits for each new regulation at the time it is promulgated would impose a large administrative burden on both EPA and the regulated community because a major permits modification would generally require the same administrative procedures as are required for initial permits (e.g., development of a draft permit, public notice, and opportunity for public hearing). As a consequence, the requirements of new standards are usually incorporated into a permit when it is renewed. For standards implemented through the RCRA permit system, the effect of this policy is to "shield" facilities that have been issued a final permit from any requirements promulgated after the issuance of the permit until the time that the permit must be renewed and the new requirements are written into the permit. Thus, this policy is often referred to as the "permit-as-a-shield" policy. Although this policy is generally applied, EPA may evaluate the need to accelerate the implementation of standards developed under RCRA and, if warranted, make exceptions to the permit-as-a-shield policy. However, the permit-as-a-shield provision applies to control of air emissions from process vents and equipment leaks regulated under Section 3004(n).

Facilities issued permits prior to the effective date of these rules do not have to comply with the 40 CFR 264, Subparts AA and BB, standards, or modify their permits to incorporate these rules, until their permit is reissued (40 CFR 124.15) or reviewed (40 CFR 270.50) by the Regional Administrator. Facilities that are issued permits after the effective date of these rules must comply with the requirements of Part 264, Subparts AA and BB, for process vents and equipment leaks.

### 8.2.2 Interim-Status Facilities

Facilities that meet RCRA interim-status requirements (i.e., compliance with the requirements of Section 3010[a] of RCRA pertaining to notification of hazardous waste activity and the requirements of 40 CFR 270.10 governing submission of Part A applications) are subject to the Part 265, Subparts AA and BB, standards on the effective date. Owners or operators of interim-status facilities must make the appropriate determinations regarding applicability and compliance and keep the required records and documentation in their operating records. Interim-status facilities that have submitted their Part B application prior to the effective date are required to modify their Part B applications to incorporate the requirements of the Part 264 air rules.

### 8.2.3 New Facilities and Newly Regulated Units

The following paragraphs describe various RCRA permit scenarios and how implementation of Subparts AA and BB occurs for newly regulated units.

With regard to newly constructed, regulated hazardous waste management units, the effective date of Subparts AA and/or BB will vary depending on the situation, including whether the TSDF is operating under RCRA interim status. For owners or operators of noninterim-status facilities, new hazardous waste management units may occur at newly constructed TSDF, at currently permitted TSDF, or at existing facilities not previously requiring a RCRA permit under Section 3005, e.g., formerly a Subtitle D operation or a Subtitle C operation with RCRA-exempt units only.

Newly constructed TSDF and existing operations not previously permitted are required to submit Parts A and B permit applications to receive a final RCRA permit prior to construction of the new unit(s) (as required under Section 270.10[f]). If these facilities meet the applicability requirements of Subparts AA and/or BB, the rules become effective on the effective date of the final RCRA permit (i.e., to operate the hazardous waste management unit, the owner or operator must have control equipment installed and operating and comply with all other requirements of the subparts upon startup of the affected units). Part B applications for new facilities submitted prior to the effective date will require modification to include the Part 264, Subparts AA and BB, rules for process vents and equipment leaks. New facilities that submit the Parts A and B application after the effective date must demonstrate in the Part B application how the air rules for process vents and equipment leaks will be met.

For currently permitted facilities, permit modification is necessary if a new hazardous waste management unit is to be added. For this situation, the effective date of Subparts AA and BB, where applicable, is the effective date of the permit modification.

Owners and operators of interim-status TSDF adding a new hazardous waste management unit (Section 270.72[c]) must submit a revised Part A application along with a justification explaining the need for the addition. If this unit meets the applicability requirements of Subparts AA and/or BB, these rules become effective on the date the Regional Administrator approves the changes contained in the revised Part A application.

An existing solid waste management unit may become a hazardous waste management unit when a solid waste becomes newly listed or identified as RCRA hazardous. If these units meet the applicability requirements of Subparts AA and/or BB, the effective date of the rule will also vary depending on the facility's permit status. For example, owners and operators of facilities not previously requiring a RCRA permit who have existing units handling newly listed or identified RCRA hazardous wastes can submit a Part A application and gain RCRA Subtitle C interim status (Section 270.70[a]). In this case, the effective date of Subparts AA and/or BB is the submittal date of the Part A application.

For interim-status TSDF handling newly listed or identified RCRA wastes (Section 270.72[a]), the owner or operator must submit a revised Part A application. If there are operations at the TSDF where Subparts AA and/or BB applies for the first time, the effective date of the rules will be the date the owner or operator submits the revised Part A application.

RCRA-permitted facilities are currently required to obtain a permit modification before managing wastes not listed in the permit (e.g., wastes that a facility is already handling that are newly listed or identified as RCRA hazardous). However, EPA has recently promulgated regulations to reduce the level of detail to obtain such a permit modification (53 FR 37912, September 28, 1988). The effective date of this type of permit modification will also be the effective date for applicable Subparts AA and/or BB regulations.

For facilities with hazardous waste management units that previously were not subject to control requirements because the wastes in the units did not contain organics in concentrations greater than the applicability criterion of 10 ppmw or 10 percent, whichever applies, the owner or operator would be required to comply with all Subpart AA or BB requirements on the date that the facility or waste management units become affected by the rules (i.e., the date the facility begins to manage wastes in the units with organic concentrations greater than 10 ppmw for Subpart AA or greater than 10 percent for Subpart BB), irrespective of any change in permit status that is required by the change in concentration. For the process vent emission rate limit, the situation is somewhat different. TSDF process vents associated with the distillation/separation operations specified in the rule that manage waste with organics concentrations of 10 ppmw or greater are affected by the regulation regardless of whether the facility emissions are above or below the emission rate limit. Therefore, any change in the facility operations that results in a TSDF going above or below the emission rate limit does not cause a change in the applicability of the facility to Subpart AA. The final rules for process vents require that owners or operators of TSDF subject to the provisions of Subpart AA: (a) reduce total organic emissions from all affected vents at the facility to below 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 ton/yr), or (b) install control devices that reduce total organic emissions from all affected vents at the facility by 95 weight percent or, in the case of enclosed combustion devices, to a total organic compound concentration of not more than 20 ppmv, expressed as the sum of actual compounds, on a dry basis corrected to 3 percent oxygen. One of these conditions must be met at all times; the facility's emission rate determination also must at all times reflect current design and operation and wastes managed in the affected units.

### 8.2.4 Omnibus Permitting Authority

The permitting authority cited by Section 3005 of RCRA and codified in Section 270.32(b)(2) states that permits issued under this section "...shall contain such terms and conditions as the Administrator or State Director determines necessary to protect human health and the environment." This section, in effect, allows permit writers to require, on a case-by-case basis, emission controls that are more stringent than those specified by a standard. This omnibus authority should be used in situations where, in the permit writer's judgment, there is an unacceptably high residual risk after application of controls required by an emission standard. The EPA intends to prepare a risk guidance document to be used by permit writers to help identify facilities that would potentially have high residual risk. The guidance will include procedures to be used to identify potentially high risk facilities and will include guidance for making a formal, site-specific risk assessment.

### 8.2.5 Part B Information Requirements

In reviewing the Part B application, permit writers should verify that the information required by the air rules and other RCRA rules is included in the application and that acceptable methods (appropriate test methods and/or engineering judgment) have been used to generate the information. The application is required to include documentation of the determinations of hazardous waste management unit equipment and process vents at the facility not affected by these standards (e.g., equipment that will not contain or contact hazardous wastes with concentrations equal to or greater than 10-percent organics). Test methods for determining the total organic content of the hazardous waste stream that is managed in a unit or is contained in or contacts equipment, as well as the process vent emissions, are referenced in Sections 264.1063 and 265.1063 and are discussed in Chapter 6.0 of this document. The application also should contain an implementation plan and schedule (discussed further in Section 8.3) indicating dates by which design and construction of any control devices required to comply with the standards will be completed.

The Part B application also must include information and data documenting that the process vent emission rate limit is or will be met with the installation of controls that will reduce the total organic emissions from all affected vents at the facility to below 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 ton/yr) or that reduce the total organic emissions from all affected vents at the facility by 95 weight percent. The process vent emission rate can be determined by engineering calculations or source tests.

As required by the equipment leak provisions, analyses documenting that equipment is in heavy-liquid service and documentation verifying compliance with the equipment leak standard must be submitted with the Part B application. This documentation includes the reports and records required under the equipment leak provisions as well as other applicable RCRA information requirements.

The permit writer's review of the Part B information specific to these air rules is estimated to require from 8 to 16 labor hours per facility application. This includes the completeness check, technical evaluation, and permit preparation.

## 8.3 COMPLIANCE

Both the process vent provisions (i.e., determination of waste organic content, emission rates, and control device efficiencies) and the equipment leak provisions are "self-implementing"; i.e., it is clear from the language of the standards what facilities are affected and what the requirements are for each affected facility. As a result, site-specific negotiations between facility owner/operators and RCRA permit writers are not necessary to implement the standards.

Therefore, interim-status facilities can comply with the rules without awaiting permit action. The self-implementing nature of the rules is achieved by including specific criteria for facility owners and operators to identify waste management units that are subject to the regulations and by clearly specifying the emission control and administrative requirement of the rules.

The criteria for applicability are that certain hazardous waste management units at new and existing TSDF that need authorization to operate under RCRA Section 3005 are covered by the rules. The applicability includes all hazardous waste management units and recycling units at facilities that require RCRA permits. For the equipment leak standards to apply, the equipment must contain or contact hazardous wastes with a 10-percent or more total organics concentration. For the process vent standards to apply, the vents must be associated with specific hazardous waste management units, i.e., distillation, fractionation, thin-film evaporation, solvent extraction, and air on steam stripping operations, that manage wastes with 10 ppmw or greater total organics concentration.

Control requirements in the regulations include specific design requirements for equipment and specific performance criteria (i.e., a weight-percent reduction and a volume concentration limit) for emission control devices. Provisions of the standards also list specific types of equipment required. Owners and operators who use one of the listed types of equipment within the specified design and operational parameters would therefore be in compliance with the regulation as long as the required design, inspection, monitoring, and maintenance provisions were met. Specifications for emission controls that achieve at least a 95-weight-percent reduction in organic emissions are somewhat less specific, but engineering design practices are sufficiently established that the combination of a good control device design and subsequent monitoring of operating parameters, as required by the final regulation, would offer reasonable assurance that the specified emission reduction is being achieved. Regardless of the type of control selected, owners and operators must maintain their own records of control device design, installation, and monitoring and must submit reports identifying exceedances of monitored control device parameters. Periodic review of the required reports and records by EPA may be used to ensure compliance.

Consistent with Section 3010 of RCRA, the effective date of the process vent and equipment leak rules is 6 months following promulgation. Owners and operators of TSDF with existing waste management units subject to the provisions of Subparts AA and BB must achieve compliance with the process vent and equipment leak control and monitoring requirements on the effective date of these rules (i.e., 6 months following promulgation) except where compliance would require the installation of a closed-vent system and control device. Information developed under other EPA regulations has shown that, in some cases, the design, construction, and installation of a closed-vent system and control device can take as long as 24 months to complete. As a result, EPA is allowing up to 24 months from the promulgation date of the regulation for facilities to complete installation if they are required to install a closed-vent system and control device and if they can document that installation of the emission controls cannot reasonably be expected to be completed earlier. In these circumstances, owners/operators are required to develop an implementation schedule that indicates dates by which the design and construction of the necessary emission controls will be completed. This implementation schedule must show that compliance with the final standards would be achieved within a period of no more than 2 years from promulgation and must be included as part of the facility's operating record on the effective date of these final rules. Changes in the implementation schedule are allowed within the 24-month timeframe if the owner or operator documents that the change cannot reasonably be avoided.

If installation of a control device is necessary for existing, regulated units to comply with either Subpart AA or BB, up to 24 months may be allowed from the promulgation date for the installation. This extension would also apply to those facilities that are brought under regulation because new statutory or regulatory amendments under RCRA that render the facility subject to the provisions of Subparts AA and BB (e.g., units handling wastes newly listed or identified as hazardous by EPA). That is, the owner or operator may be allowed up to 18 months from the effective date of the statutory or regulatory amendment (24 months from the date the new listing is published) to complete installation of a control device. However, for facilities adding new waste management units, EPA believes that the lead time involved in such actions provides adequate time for owners and operators to design, procure, and install the required controls. Therefore, all new units must comply with the rules immediately (i.e., must have control equipment installed and operating on startup of the unit).

The implementation/compliance schedule for the air emission standards for process vents and equipment leaks at existing TSDF is as follows:

- 180 days following promulgation, the new Subpart AA and BB standards become effective; all facilities become subject to the new standards.
- On the effective date of the standards, compliance with the standards is required. Each facility that does not have the control devices required by the standards in place must have one of the following in the facility's operating record: (1) an implementation schedule indicating when the controls will be installed, or (2) a process vent emission rate determination that documents that the emission rate limit is not exceeded (therefore, controls are not required).
- No later than 18 months following the effective date (2 years following promulgation), any control devices required by the standards for process vents and equipment leaks must be installed at all facilities.
- All permits issued after the effective date must incorporate the standards.

Implementation/compliance of the air emission standards at newly regulated facilities not previously requiring a RCRA permit (e.g., those who have existing units handling newly listed or identified hazardous wastes) is as follows:

- 180 days following the date the new statutory or regulatory amendment is promulgated (e.g., the date a managed waste is listed or identified as hazardous), the standards become effective; facilities become subject to the Subpart AA and/or BB standards.
- On the effective date of the standards, each facility that does not have the control devices required by the standards in place must have one of the following in the facility's operating record: (1) an implementation schedule indicating when the controls will be installed, or (2) a process vent emission rate determination that documents that the emission rate limit is not exceeded (therefore, controls are not required).
- No later than 18 months following the effective date, the controls required by the standards must be installed at all facilities.

The requirements for facility compliance with the air emission standards for process vents and equipment leaks are summarized in Chapter 3.0 of this document. Section 7.1 presents the inspection, monitoring, and testing requirements. Section 7.2 presents the recordkeeping requirements. Reporting requirements are outlined in Section 7.3. Information on enforcement is contained in Section 8.4.

To demonstrate compliance, facilities must document their waste determinations, emission estimates, and control device efficiencies with design/engineering analyses based on criteria contained in the rules (e.g., either engineering calculations or source tests can be used to document compliance with the emission cutoff); facilities must maintain these analyses and also monitoring, leak detection, and repair records in their operating record. It is important to point out that the facility's process vent emission rate determination must at all times reflect the facility's current waste management unit designs and wastes managed. If the owner/operator takes any action that would result in the determination no longer being appropriate to the facility's operations, then a new waste and/or emission rate determination is required (Sections 264.1035 and 265.1035) (e.g., if a waste of different composition is managed, the operating hours of the affected management units are increased beyond what was originally considered, or a new affected unit is added that may impact regulatory status).

## 8.4 AGENCY ENFORCEMENT

The EPA's Regional RCRA Enforcement Officials and the Headquarters RCRA Enforcement Division have the primary responsibility for enforcement of the standards.

The Part B permit application information (Section 270.24) will establish the specific process vents and equipment that are affected by the rule, whether process vent controls and/or an LDAR program are needed, and will identify the control devices that have been selected to achieve compliance as well as establish the compliance schedule. The Part B permit application information for most facilities will be available to the RCRA inspector for examination before the initial inspection and will include all of the information required (with the exception of monthly LDAR records) to determine initial compliance. LDAR monitoring and the recording of monitoring results are required to be performed monthly. Through examination of the Part B application and any exceedance reports submitted by the owner/operator, the inspector should be able to prepare before the inspection (e.g., examine analyses of the achievable emission reductions), thereby minimizing the time required at the facility.

During the initial and subsequent followup inspections, enforcement personnel should inspect the records that the facility is required to maintain by these and other RCRA rules to determine compliance. The initial inspection of the facilities affected by the requirements of the process vent and equipment leak standards can begin immediately after the effective date of these rules (i.e., 6 months after promulgation).

A checklist of items that should be inspected at the facility during the initial and followup inspections is included in this technical guidance document (Table 8-1). Followup inspections for this standard can be performed concurrently with the annual inspection of the facility under other RCRA standards. Each initial and followup inspection, including writing a report, is estimated to range from about 11 labor hours for a small commercial recycling facility up to about 38 labor hours for a large TSDF with numerous management processes with equipment subject to the standards.

TABLE 8-1. CHECKLIST FOR INITIAL AND FOLLOWUP INSPECTIONS

A. Initial Inspection:

- Verify determination of processes and equipment at the facility subject to and not subject to the standards. Assess how the determinations are made.

Process Vent Requirements

- Verify that the waste stream determination of organics content is documented for each distillation/separation process unit.
- Evaluate whether the emission rate limit is being met or will be met.
    - -- Are the facility throughput estimates justifiable?
    - -- Are emission estimates reasonable given chemical characteristics and throughputs?
    - -- Are source test results available?
    - -- Are the controls identified in the compliance plan applicable and well designed?
- Verify that the compliance schedule, if needed, is in the facility's operating log, and determine whether the compliance schedule is being followed.

Equipment Leak Requirements

- Evaluate analyses of equipment in heavy-liquid service.
    - -- Is the hazardous waste management unit design capacity reasonable?
    - -- Are all hazardous waste feed and effluent streams identified?
    - -- Is the analysis of hazardous waste streams consistent with the facility waste manifest records?
- Check records of monthly leak detection monitoring.
- Verify that leaking equipment has been tagged.
- Review records of repair attempts, delay of repair, etc.

(continued)

TABLE 8-1 (continued)

- Verify the determination of valves that are difficult or unsafe to monitor.
- Review records for equipment covered by alternative requirements.

B. Followup Inspection:

- Follow up to see that deficiencies identified in initial inspection have been corrected.

Process Vent Requirements

- Verify that controls identified in the compliance plan have been installed and are operating.
- Review the monitoring records to determine that controls are operating within design specifications.
- Evaluate whether the emission rate limit is being met.
    - -- Are there any new process vents subject to the standards at the facility?
    - -- Are the original facility wastes and throughput rates still applicable?
    - -- Are source test results available?

Equipment Leak Requirements (same checklist as for initial inspection)

# 9.0 TRAINING

## 9.1 INTRODUCTION

The objectives of any training program for personnel responsible for the implementation of the RCRA process vent and equipment leak organic air emission standards, including RCRA permit writers/reviewers, RCRA enforcement personnel, general RCRA staff (new hires), and operators/owners of TSDF, should be:

- To make personnel aware of applicable process vent and equipment leak emission sources they may encounter
- To provide the knowledge and skills necessary to determine if the owner/operator is complying with the process vent and equipment leak organic air emission standards
- To make personnel aware of the capabilities and limitations of the various emission control techniques.

RCRA permit writers/reviewers, RCRA enforcement personnel, general RCRA staff (new hires), and operators/owners of TSDF must recognize and understand the potential emission sources associated with the management of organic containing waste at hazardous waste TSDF and the various emission control techniques available. In particular, personnel actively involved with and/or responsible for compliance should be thoroughly familiar with the regulation and its requirements and the information contained in this guidance document, as well as have a basic understanding of RCRA and its objectives.

The level of necessary and required training should be consistent with a person's job function and responsibilities. The training program should involve classroom instruction on topics involving process vent emissions, fugitive emissions from equipment (e.g., pumps and valves), and control techniques for these emission sources. Films, tapes, slides, etc., can also be used. Some training classes provide onsite instruction and may include hands-on experience, which is also recommended. All involved persons should complete refresher training, when possible, to reinforce their initial training and to receive an update on any new information.

## 9.2 TRAINING PROGRAMS

Personnel should be adequately trained to a level commensurate with their job function and responsibilities. Specific course recommendations and areas to be covered in training sessions are included in Tables 9-1 and 9-2. A list of recommended literature is also provided below:

### Equipment Leak Fugitive Emissions

- EPA
  November 1980.
  VOC Fugitive Emissions in Synthetic Organic Chemicals Manufacturing Industry--Background Information for Proposed Standards. EPA-450/3-80-033A. PB-81-152167.

- EPA:ESD/OAQPS
  November 1980.
  Benzene Fugitive Emissions--Background Information for Proposed Standards. Draft EIS. EPA-450/3-80-032a. PB-81-151664.

- EPA
  December 1980.
  Organic Chemical Manufacturing--Volume 3: Storage, Fugitive, and Sources. EPA-450/3-80-025. PB81-220527.

- EPA:ESD
  November 1982.
  VOC Fugitive Emissions in Petroleum Refining Industry--Background Information for Proposed Standards. EPA-450/3-81-015a. PB-83-157743.

- EPA/OAQPS/ESD
  April 1982.
  Fugitive Emissions Sources of Organic Compounds--Additional Information on Emissions, Emission Reductions, and Costs. EPA-450/3-82-010. PB-82-217126.

- EPA/OAQPS
  March 1984.
  Guideline Series--Control of Volatile Organic Compound Leaks for Synthetic Organic Chemical and Polymer Manufacturing Equipment. EPA-450/3-83-006. PB-84-189-372.

**Table 9-1. Recommended Training (EPA sponsored)**

| Course No. | Course Title | Emphasis of Training |
|---|---|---|
| 415 | Control of Gaseous Emissions | Students successfully completing this course will be able to evaluate systems typically employed for controlling emissions of gaseous pollutants, including systems operation and review of permit applications. Evaluation may be associated with inspection or for judging whether a planned system will meet regulatory standards. A primary focus of the course is on calculations that are needed to check system design. The course helps students to develop an understanding of the process factors that guide selection of control devices for various abatement requirements; it also helps students to develop an ability to select and size a gaseous pollutant control device. A scientific calculator is required for class exercises.<br>*Course Sponsor:* Air Pollution Training Institute<br>*Desired Background:* Engineering or Scientific degree<br>*Availability:* All courses offered by the Air Pollution Training Institute are offered on an annual basis.<br>*Contact:* Betty Dodson (919) 541-2497 |
| 445 | Baseline Source Inspection Techniques | This advanced course in air pollution control equipment inspection and problem diagnosis is designed for Agency inspectors and control system operating personnel. This course presents discussions on the baseline techniques for equipment inspection and evaluation. These techniques utilize site-specific information to facilitate the identification of shifts in significant operating variables. The techniques presented in the course will be useful in diagnosing complex control system operating problems that are often due to a combination of factors. It will also be helpful in the early identification of problems, before excess emissions or serious equipment damage occurs. Operating problems of a number of control systems are reviewed to illustrate the baseline technique.<br>*Course Sponsor:* Air Pollution Training Institute<br>*Desired Background:* Course 413 (Control of Particulate Emissions), 415 (Control of Gaseous Emissions), and 427 (Combustion Evaluation) or equivalent field experience are required.<br>*Availability:* All courses offered by the Air Pollution Training Institute are offered on an annual basis.<br>*Contact:* Betty Dodson (919) 541-2497 |
| 456 | Fugitive VOC Leak Detection | This course is intended for engineering and field monitoring personnel. It presents an overview of the organic chemicals, fugitive emission points, monitoring equipment, quality assurance procedures, and the design of inspections. Hands-on demonstrations of the most commonly used monitoring equipment are included.<br>*Course Sponsor:* Air Pollution Training Institute<br>*Desired Background:* Successful completion of courses SI:445 (Introduction to Baseline Source Inspection Techniques) and/or APTI 445 (Baseline Source Inspection Techniques) and APTI 446 (Inspection Procedures and Safety).<br>*Availability:* All courses offered by the Air Pollution Training Institute are offered on an annual basis.<br>*Contact:* Betty Dodson (919) 541-2497 |

*(continued)*

Table 9-1. (con.)

| Course No. | Course Title | Emphasis of Training |
|---|---|---|
| 482 | Sources and Control of Volatile Organic Air Pollutants | The student successfully completing this course will be able to evaluate systems typically employed for the control of volatile organic emissions, including systems in operation and as represented in VOC control plans. Evaluation of systems in operation identifies sub-optimal features and is for the purpose of guiding regulatory action. Evaluation of planned systems is for the purpose of determining whether a VOC control plan is likely to meet the control objective it addresses. The course emphasizes calculations needed to check system efficiency. Course content draws from EPA Control Technique Guidelines and includes recent NSPS regulations.<br>*Course Sponsor:* Air Pollution Training Institute<br>*Desired Background:* Course SI:422 (Air Pollution Control Orientation Course; 3rd Edition) or have a minimum of six months of applicable work experience.<br>*Availability:* All courses offered by the Air Pollution Training Institute are offered on an annual basis.<br>*Contact:* Betty Dodson (919) 541-2497 |
| SI:412D | Problem Workbook for Control of Gaseous and Particulate Emissions | This self-instructional course is designed for engineers and other technical personnel responsible for making and reviewing calculations concerning air pollution control equipment. The problems workbook contains three parts: a glossary of common terms with explanations; a units operations section containing the basic principles of chemistry, physics, and thermodynamics that are required in air pollution control equipment calculations; and a problem section with solutions.<br>*Course Sponsor:* Air Pollution Training Institute<br>*Availability:* No tuition fees are currently applicable to the Self-Study Courses (SI). The materials for these courses are provided on a loan basis.<br>*Contact:* Betty Dodson (919) 541-2497 |
| SI:417 | Controlling VOC Emissions from Leaking Process Equipment | This course is designed for technical people involved in monitoring industries for VOC emissions from leaking process equipment. The course reviews in detail the sources of fugitive VOC emissions and the procedures and equipment used to detect the leaks.<br>*Course Sponsor:* Air Pollution Training Institute<br>*Availability:* No tuition fees are currently applicable to the Self-Study Courses (SI). The materials for these courses are provided on a loan basis.<br>*Contact:* Betty Dodson (919) 541-2497 |

*(continued)*

Table 9-1. (con.)

| Course No. | Course Title | Emphasis of Training |
|---|---|---|
| SI:428A | Introduction to Boiler Operation | Designed for engineers and other technical persons responsible for inspecting boilers, this course presents an introduction to the operation of boilers. This will be the first in a series of four (or five) courses on inspecting and/or operating different types of boilers—small package boilers, commercial boilers, industrial boilers, and utility boilers.<br>*Course Sponsor:* Air Pollution Training Institute<br>*Availability:* No tuition fees are currently applicable to the Self-Study Courses (SI). The materials for these courses are provided on a loan basis.<br>*Contact:* Betty Dodson (919) 541-2497 |
| SI:431 | Air Pollution Control Systems for Selected Industries | This course is an introduction to the fundamental operating characteristics of particulate and gaseous pollutant emission control systems. It reviews physical, chemical, and engineering principles of control devices and the application of control systems to several types of industrial processes.<br>*Course Sponsor:* Air Pollution Training Institute<br>*Availability:* No tuition fees are currently applicable to the Self-Study Courses (SI). The materials for these courses are provided on a loan basis.<br>*Contact:* Betty Dodson (919) 541-2497 |
| SI:445 | Introduction to Baseline Source Inspection Techniques | This course was designed for the air pollution field inspector and industrial air pollution control equipment operators. It covers the basics of the baseline inspection technique for air pollution control equipment. This technique is based on the use of site-specific data to evaluate shifts in operating conditions. Most major types of air pollution control devices and auxiliary systems are covered. Inspection procedures, data collection, data recording, and interpretation are explained. Review problems and questions are presented.<br>*Course Sponsor:* Air Pollution Training Institute<br>*Availability:* No tuition fees are currently applicable to the Self-Study Courses (SI). The materials for these courses are provided on a loan basis.<br>*Contact:* Betty Dodson (919) 541-2497 |
|  | Core Training Program | The Core Training Program is designed for entry-level State inspectors at RCRA sites. The program is composed of three courses: RCRA orientation, inspector training, and permit writers training.<br>*Course Sponsor:* EPA/ASTSWMO<br>*Availability:* The inspector course and the permit writers course are available on an annual basis. The orientation course is currently under development.<br>*Contact:* Mary Anthony (202) 624-5828 |
|  | Workshop on Hazardous and Toxic Air Pollutant Control Technologies and Permitting Issues | Information presented in this workshop should be of interest to Federal, State, and local officials, industry personnel, and consultants involved in the hazardous and toxic air pollution field. The purpose of this workshop series is to transfer technical information on hazardous and toxic air pollutant control technologies and permitting issues. Topics discussed include: combustion-related technologies; carbon adsorption; absorption; fugitive equipment leaks; and particulate control technologies.<br>*Course Sponsor:* STAPPA/ALAPCO<br>*Availability:* The availability of this workshop depends on the availability of funds from its sponsor to support its existence.<br>*Contact:* Kirt Cox (919) 541-5399 |

SI = Self-Instructional

Table 9-2. Recommended Training (Non-EPA sponsored)

| Course Title | Emphasis of Training |
|---|---|
| VOC Inspection Techniques | The VOC Inspection Techniques workshop provides inspectors with background information on various VOC-emitting industries, technical control strategies, and inspection techniques. A three-hour site visit, included in the workshop, demonstrates some of the inspection techniques. Demonstrations of several VOC detection instruments provide hands-on opportunity for the inspectors. Short lectures on control device inspection techniques and operating principles for carbon adsorbers and incinerators are presented. VOC source categories include solvent metal cleaning, drycleaning, surface coating, gasoline marketing, petroleum refining, pharmaceutical manufacturing, synthetic organic chemical manufacturing, pneumatic rubber tire making, the use of cutback asphalt, graphic arts, etc.<br>*Course Sponsor:* PEI<br>*Availability:* This workshop is available when requested by a significant number of persons.<br>*Contact:* Dave Dunbar (919) 688-6338 |
| RCRA Facility Compliance Training | This three-day workshop summarizes RCRA interim-status standards, inspection protocols, and safety procedures. The workshop describes hazardous waste treatment, storage, and disposal facilities and requirements for the design of a management program for such facilities. Inspection protocols are discussed that are compatible with EPS's RCRA inspection manual.<br>*Course Sponsor:* PEI<br>*Availability:* This workshop is available when requested by a significant number of persons.<br>*Contact:* Dave Dunbar (919) 688-6338 |
| Permit Review | This three-day workshop is designed for Agency engineers and personnel who are responsible for permit review. The workshop covers administrative and technical considerations in depth. It discusses manpower requirements for various levels of review; optimum utilization of Agency personnel; permit processing mechanics; fabric filters; scrubbers; mechanical collectors; operating features and design criteria for control equipment; operating and maintenance considerations; modeling of control equipment performance; corrosion prevention; compliance testing provisions; siting requirements; and information retrieval systems.<br>*Course Sponsor:* PEI<br>*Availability:* This workshop is available when requested by a significant number of persons.<br>*Contact:* Dave Dunbar (919) 688-6338 |
| Field Training | As a followup to classroom instruction, many agencies have requested personalized instruction in the use of the inspection equipment and analysis methods in actual field applications. In cooperation with the host agency, the course sponsor selects representative industrial sources and negotiates with those sources to conduct inspections that demonstrate various inspection techniques.<br>*Course Sponsor:* PEI<br>*Availability:* This workshop is available when requested by a significant number of persons.<br>*Contact:* Dave Dunbar (919) 688-6338 |

Table 9-2. (con.)

| Course Title | Emphasis of Training |
|---|---|
| Air Pollution Control | In this course, air pollution causes, transport, effects, and monitoring are reviewed as well as principles and terminology of air pollution control engineering. A major emphasis is on methods for prevention, control, and solution of atmospheric environmental problems. Process design and selection of both particulate and gaseous collection equipment are emphasized. Methods of avoiding common operating problems are discussed. A background knowledge of general chemical and petrochemical processes is assumed, but a high degree of mathematical sophistication is not required.<br>*Course Sponsor:* AIChE<br>*Availability:* This course is offered on an annual basis<br>*Contact:* AIChE Continuing Education Registrar (212) 705-7526 |
| Industrial Control Equipment for Gaseous Pollutants | This course reviews the design criteria for control equipment and presents the underlying principles and mechanisms involved. The course content includes: activated carbon and molecular sieve adsorption columns; condensers; and thermal and catalytic incinerators.<br>*Course Sponsor:* APCA<br>*Availability:* This course is offered on an annual basis.<br>*Contact:* Dan Russel (412) 232-3444 |

## Process Vent Emissions

- EPA
  December 1980.
  Organic Chemical Manufacturing--Volume 4: Combustion Control Devices. EPA-450-3-80-026. PB-81-220535.

- EPA
  December 1980.
  Organic Chemical Manufacturing--Volume 5: Adsorption, Condensation, and Absorption Devices. EPA-450/3-80-027. PB-81-220543.

- EPA
  December 1983.
  Distillation Operations in Synthetic Organic Chemical Manufacturing--Background Information for Proposed Standards.
  EPA-450/3-83-005a. PB-84-214006.

- EPA/OAQPS/ESD
  June 6, 1988.
  Carbon Adsorption for Control of VOC Emissions: Theory and Full Scale System Performance. EPA 450/3-88-012.

- APCA Publications
  December 1981.
  Control of Gaseous Emissions. EPA-450/2-81-005.
  (412) 232-3444.

## Waste Stream Test Methods

- EPA/OSW
  Second Edition,
  Revised December 1987.
  Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. SW-846. PB87-120-291.

Note: These documents are available through the EPA library and through the National Technical Information Service (NTIS). Literature having a EPA number (e.g., EPA-450/3-80-033A) is available at the following address and phone number:

Environmental Protection Agency
Library Services Office
MD-35
Research Triangle Park, NC 27711
(919) 541-2777

Literature having a PB number can be obtained through NTIS at the following address and phone number:

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
(703) 487-4650

Control of Gaseous Emissions can be obtained through APCA Publications at the following address and phone number:

APCA Publications
P.O. Box 2861
Pittsburgh, PA 15230
(412) 232-3444

ASTM methods are available from the Annual Book of ASTM Standards at the following address and phone number:

American Society for Testing and Materials
1916 Race St.
Philadelphia, PA 19103
(215) 299-5400

EPA Reference Method 21, "Determination of Volatile Organic Compound Leaks," contained in Appendix A of 40 CFR 60 (Stock No. 869-004-00137-1), is available from the following office:

U.S. Government Printing Office
Washington, DC 20402-9325
(202) 783-3238

# APPENDIX A

# FEDERAL REGISTER NOTICE

**ENVIRONMENTAL PROTECTION AGENCY**

**40 CFR Parts 260, 261, 264, 265, 270, and 271**

**[FRL-3814-3]**

## Hazardous Waste Treatment, Storage, and Disposal Facilities—Organic Air Emission Standards for Process Vents and Equipment Leaks

**AGENCY:** Environmental Protection Agency (EPA).

**ACTION:** Final rule.

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**SUMMARY:** The EPA is today promulgating standards that limit organic air emissions as a class at hazardous waste treatment, storage, and disposal facilities (TSDF) requiring a permit under subtitle C of the Resource Conservation and Recovery Act (RCRA). Today's action is the first part of a multiphased regulatory effort to control air emissions at new and existing hazardous waste TSDF. The rule establishes final standards limiting organic emissions from (1) process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping operations that manage hazardous wastes with 10 parts per million by weight (ppmw) or greater total organics concentration, and (2) leaks from equipment that contains or contacts hazardous waste streams with 10 percent by weight or greater total organics. These standards were proposed in the **Federal Register** on February 5, 1987 (52 FR 3748).

The final standards are promulgated under the authority of section 3004 of the Hazardous and Solid Waste Amendments (HSWA) to the RCRA. The EPA is required by section 3004(n) of RCRA to promulgate standards for the monitoring and control of air emissions from hazardous waste TSDF as necessary to protect human health and the environment. The EPA plans to promulgate additional standards under this section in two further phases. Phase II will consist of air standards for organic emissions from surface impoundments, tanks, containers, and miscellaneous units. These standards are scheduled for proposal later this year. In Phase III, the residual risk from the first two phases will be assessed and, if necessary, EPA will develop further regulations or guidance to protect human health and the environment from the effects of TSDF air emissions.

**EFFECTIVE DATE:** This final rule is effective on December 21, 1990. The incorporation by reference of certain publications listed in the regulations is approved by the Director of the Federal Register as of September 5 and October 11, 1989.

**ADDRESSES:** The official record for this final rulemaking is contained in Docket No. F-90-AESF-FFFFF. This docket and the proposal docket (Docket No. F-86-AESP-FFFFF) are available for public inspection at the EPA RCRA Docket Office (OS-300) in room 2427M of the U.S Environmental Protection Agency, 401 M Street SW., Washington, DC 20460. Additional information concerning the development of the equipment leak standards is contained in Docket No. A-79-27, which is available for public inspection at EPA's Central Docket Section, room 2903B, Waterside Mall, 401 M Street SW., Washington, DC 20460. For further information, see the discussion of supporting documentation for the rules under section X of this preamble.

*Background information document:* The background information document (BID) for the final standards may be obtained from the U.S. EPA Library (MD-35), Research Triangle Park, North Carolina 27711, telephone (919) 541-2777. Please refer to "Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)—Background Information for Promulgated Organic Emission Standards for Process Vents and Equipment Leaks" (EPA-450/3-89-009). The EPA has prepared a technical guidance document to aid in implementation of these rules. This document may also be obtained from the U.S. EPA Library (see above address). Please refer to "Hazardous Waste TSDF—Technical Guidance Document for RCRA Air Emission Standards for Process Vents and Equipment Leaks" (EPA-450/3-89-21).

**FOR FURTHER INFORMATION CONTACT:** The RCRA Hotline, toll-free at (800) 424-9346. For further information on regulatory aspects of these standards, contact Rick Colyer, Standards Development Branch, Emission Standards Division (MD-13), U.S. Environmental Protection Agency, Research Triangle Park, North Carolina 27711, telephone number (919) 541-5262. For further information on the technical aspects of these standards, contact Robert Lucas, Chemicals and Petroleum Branch, telephone number (919) 541-0884, at the same address. For further information on test methods associated with these standards, contact Terry Harrison, Emission Measurement Branch, telephone number (919) 541-5233, at the same address as above.

**SUPPLEMENTARY INFORMATION:** The contents of today's preamble are listed in the following outline:

I. Authority
II. Summary of Final Standards
  A. Vents on Hazardous Waste Management Process Units
  B. Equipment Leaks on Hazardous Waste Management Process Units
III. Background
  A. Regulatory Authority
  B. Regulatory Scope of Today's Standards
  C. Air Standards under RCRA Section 3004(n)
  D. Other RCRA Air Standards
  E. Relationship of Air Standards to Other Subtitle C Rules
  F. Relationship of Today's Final Standards to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
IV. Applicability and Requirements of Proposed Process Vent and Equipment Leak Standards
V. Applicability and Requirements of Today's Final Standards
  A. Scope of Final Standards
  B. Standards for Process Vents
  C. Equipment Leak Standards
  D. Summary of Changes from Proposal
  E. Relationship of RCRA Exemptions to Final Standards
VI. Summary of Comments and Responses
  A. Regulatory Issues
  B. Standards and Applicability
  C. Control Technology
  D. Impact Analyses Methodologies
  E. Implementation and Compliance
VII. Summary of Impacts of Final Standards
  A. Overview of the Source Category
  B. Use of Models in the Regulatory Development Process
  C. Emission Impacts
  D. Ozone Impacts
  E. Health Risk Impacts
  F. Cost Impacts
VIII. State Authorization
  A. Applicability of Rules in Authorized States
  B. Effect on State Authorizations
IX. Implementation
X. Administrative Requirements
  A. Regulatory Impact Analysis
  B. Regulatory Flexibility Act
  C. Paperwork Reduction Act
  D. Supporting Documentation
  E. List of Subjects

## I. Authority

These regulations are promulgated under the authority of sections 1006, 2002, 3001-3007, 3010, 3014, and 7004 of the Solid Waste Disposal Act of 1970, as amended by RCRA, as amended (42 U.S.C. 6905, 6912, 6921-6927, 6930, 6934, and 6974).

## II. Summary of Final Standards

The standards limit emissions of organics from certain process vents and equipment leaks at new and existing hazardous waste TSDF requiring a permit under RCRA subtitle C (i.e., permitted TSDF and TSDF that need authorization to operate under RCRA section 3005(e)). This applicability includes all hazardous waste management units that require RCRA permits and recycling units that are not subject to RCRA permit requirements, if, independent of today's final rules, a RCRA permit is needed for another part of the facility operations.

### *A. Vents on Hazardous Waste Management Process Units*

Today's final standards are applicable to vents on waste management units that manage hazardous waste with an annual average total organics concentration of 10 ppmw or greater (hereafter referred to as "process vents") and specifically include (1) process vents on distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping operations and vents on condensers serving these operations; and (2) process vents on tanks (e.g., distillate receivers, bottoms receivers, surge control tanks, separator tanks, and hot wells) associated with distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping processes if emissions from these process operations are vented through the tanks. Up-to-date information and data used to determine whether or not a hazardous waste management unit and its associated process vent(s) are subject to the subpart AA standards must be maintained in the facility operating record (§ 264.1035(f) and § 265.1035(f)). For example, documentation of a waste analysis showing that the waste managed in the unit is less than the 10-ppmw applicability criterion must be kept in the facility operating record.

The final rules for process vents require that owners or operators of TSDF subject to the provisions of new subpart AA: (1) Reduce total organic emissions from all affected process vents at the facility to below 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 ton/yr), or (2) install and operate a control device(s) that reduces total organic emissions from all affected process vents at the facility by 95 weight percent. The owner or operator of the facility must determine through test data or engineering judgment and calculations that the facility is not expected to exceed the emission rate limit of 1.4 kg/h and 2.8 Mg/yr. Facilities with organic emissions from affected vents that never exceed the emission rate limit will not be required to install controls or monitor process vent emissions under this rule. For all other affected facilities, the owner or operator must install controls to reduce total facility process vent emissions from all affected vents below the emission rate limit or to reduce total facility process vent organic emissions after primary recovery by 95 percent; if enclosed combustion devices are used, the owner/operator has the option of reducing the organic concentration of each affected vent stream at the facility to no more than 20 parts per million by volume (ppmv). Selection of the emission rate limit is addressed further in section VI.B below and in chapters 4.0 and 7.0 of the BID.

The final standards for process vents do not require the use of any specific types of equipment or add-on control devices. Condensers, carbon adsorbers, incinerators, and flares are demonstrated emission control equipment for the regulated processes, although the choice of control is not limited to these.

To demonstrate compliance with the process vent provisions, TSDF owners/operators must document process vent emissions and emission reductions achieved by add-on control devices and certify the emission reduction capability of the control equipment. Documentation must (1) identify affected process vents, provide the throughput and operating hours of each affected unit, and provide emission rate determinations for each affected vent and for the overall facility (i.e., the total emissions for all affected vents at the facility); and (2) show whether installed add-on control devices achieve the emission rate limit by design and during operation. Where the emission rate limit is not attained, documentation must show whether the add-on control devices achieve a 95-percent reduction in organics or the 20-ppmv organics concentration limit by design and during operation. The documentation must include the basis for determining the design emission reduction.

The rules for process vents require that specific control device operating parameters be monitored continuously and the monitoring information be recorded in the facility operating record to ensure that the devices perform according to their design and are properly operated and maintained. For facilities with final RCRA permits, periods when monitoring indicates that control device operating parameters exceed established tolerances for design specifications must be reported semiannually. The records and reports must include dates, duration, cause, and corrective measures taken. There are no reporting requirements for interim status facilities. These monitoring and recordkeeping requirements are discussed below in section V.B and in the BID in chapter 11.0, section 11.4.

### *B. Equipment Leaks on Hazardous Waste Management Process Units*

The equipment leak standards apply to emissions from valves, pumps, compressors, pressure relief devices, sampling connection systems, and open-ended valves or lines. Under the final standards, controls for these sources are required at TSDF where the equipment contains or contacts hazardous waste streams with organic concentrations of 10 percent by weight or greater. The owner or operator of a facility may choose any of the applicable test methods identified in the final rules for determining the organic content.

To comply with the equipment leak standards, the facility owner/operator must identify all affected equipment (i.e., pumps, valves, compressors, etc., that contain or contact hazardous waste streams with at least 10-percent-by-weight organics), establish which of the affected equipment is in heavy liquid service, and determine which valves are unsafe or difficult to monitor. By the effective date of this regulation, the facility owner/operator must conduct the initial monthly monitoring survey of pumps and valves in gas/vapor or light liquid service. A number of portable volatile organic monitoring devices are capable of detecting equipment leaks. Any analyzer can be used, provided it meets the specifications and performance criteria set forth in EPA Reference Method 21 (contained in appendix A of 40 CFR part 60).

Affected compressors must have a dual mechanical seal system that includes a barrier fluid system or must be designated as having "no detectable emissions," which means an instrument reading of less than 500 ppm above background using EPA Reference Method 21. Sampling connections must have a closed-purge system. Open-ended valves or lines must have a cap, blind flange, plug, or second valve. Pressure relief devices must operate with "no detectable emissions."

Recordkeeping and monitoring are also required by the equipment leak provisions. For example, leaking equipment as determined by Method 21 must be tagged as specified in the rule, and records of repair attempts, delay of repair, etc., must be recorded in a log and included as part of the facility's operating record. Monitoring of control device operating parameters is also required if a closed-vent system and control device are installed as a result of the equipment leak standards. The standards and recordkeeping requirements are discussed below at section V.C.

## III. Background

### *A. Regulatory Authority*

In 1984, Congress passed HSWA, amending RCRA. Section 3004(n) of RCRA, as amended by HSWA, directs EPA to "* * * promulgate such regulations for the monitoring and control of air emissions at hazardous waste treatment, storage, and disposal facilities, including but not limited to open tanks, surface impoundments, and landfills, as may be necessary to protect human health and the environment." The standards being promulgated today address, in part, this congressional directive and are applicable to all TSDF that require authorization to operate under section 3005 of RCRA. These regulations are being promulgated under the authority of sections 1006, 2002, 3001–3007, 3010, 3014, and 7004 of the Solid Waste Disposal Act of 1970, as amended by RCRA, as amended (42 U.S.C. 6905, 6912, 6921–6927, 6930, 6934, and 6974).

### *B. Regulatory Scope of Today's Standards*

Today's final rules apply to facilities that treat, store, or dispose of hazardous wastes as defined in 40 CFR 261.3 and, specifically, to certain hazardous waste management units at facilities requiring RCRA subtitle C permits. This includes facilities with permits and those operating under interim status. Today's rules, codified in new subparts AA and BB of 40 CFR parts 264 and 265, are applicable to the following units at TSDF: (1) Hazardous waste management units subject to the permitting requirements of part 270 (i.e., not 90-day accumulation tanks at TSDF), and (2) hazardous waste recycling units located on hazardous waste management facilities otherwise subject to the permitting requirements of part 270. Under 40 CFR 260.10, the term "facility" means all contiguous land, and structures, other appurtenances, and improvements on the land, used for treating, storing, or disposing of hazardous waste. (Note: This definition differs from the definition of "facility" for purposes of corrective action under RCRA section 3004(u). See 50 FR 28712, July 15, 1985.)

### *C. Air Standards Under RCRA Section 3004(n)*

Air emissions from hazardous wastes are generated or released from numerous sources at TSDF, including distillation and other organic separation units, surface impoundments, tanks, containers, landfills, land treatment facilities, wastepiles, and leaks from equipment associated with these operations.

In considering the regulation of air emissions under RCRA section 3004(n) and within the RCRA regulatory framework, EPA has concluded that air emissions from hazardous waste management facilities that are subject to RCRA subtitle C should be regulated under the authority of RCRA section 3004(n). Air emissions from facilities or units that manage solid wastes that are not regulated as hazardous wastes pursuant to 40 CFR part 261 (e.g., cement kiln dust waste) and air emissions from hazardous waste from units or facilities that are exempt from the permitting provisions of 40 CFR 270.1(c)(2) (e.g., wastewater treatment units with National Pollutant Discharge Elimination System (NPDES) permits) will be subject to control techniques guidelines or standards developed as needed under either the Clean Air Act (CAA) or RCRA authority. Air emissions from wastes managed in units subject to subtitle D (nonhazardous solid wastes such as those managed in municipal landfills) also will be subject to guidelines or standards issued under CAA or RCRA authority as appropriate.

Air emissions from hazardous wastes include photochemically reactive and nonphotochemically reactive organics, some of which are toxic or carcinogenic, and also may include toxic or carcinogenic inorganic compounds. Depending on the source, particulates (including metals, aerosols of organics, dust, as well as toxics and carcinogens) also may be released or generated. These emissions, which are released to the atmosphere from a wide variety of sources within TSDF, present diverse health and environmental risks. Therefore, EPA has developed a multiphased approach for regulating TSDF organic air emissions. This approach, described generally below, reflects EPA's understanding of the problem and knowledge of applicable, effective controls at this time.

Organic emissions from TSDF managing hazardous wastes contribute to ambient ozone formation and increase cancer and other health risks. Phases I and II of EPA's TSDF regulatory approach will significantly reduce emissions of ozone precursors and air toxics and carcinogens from TSDF by controlling emissions of organics as a class rather than controlling emissions of individual waste constituents. The regulation of organics as a class has the advantage of being relatively straightforward because it can be accomplished with a minimum number of standards, whereas the control of individual toxic constituents will require multiple standards. Regulating organics as a class also makes efficient use of EPA resource, avoids many of the complexities of having multiple standards, and reduces the number of constituents for which separate standards may be required.

The health and environmental effects of ambient ozone are well documented; measured in terms of monetary losses, they total hundreds of millions of dollars each year. Other health impacts of TSDF organic emissions are summarized in section VII.D of this preamble and are discussed in more detail in the BID that accompanies this final rule and in the draft BID for Phase II organic standards titled, "Hazardous Waste TSDF—Background Information for Proposed RCRA Air Emission Standards," available in Docket F–90–CESP–FFFFF. The substantial reductions in organic emissions achievable through implementation of Phase I and Phase II controls will reduce atmospheric ozone formation as a result of reductions in TSDF emissions of ozone precursors and will reduce nationwide cancer incidence and maximum individual risk due to exposure to air toxics and carcinogens emitted from TSDF.

Specifically, Phase I (which is being promulgated as final rules today) entails the promulgation of standards for the control of organic air emissions from selected hazardous waste management processes and equipment leaks. As discussed in the February 1987 proposal, EPA chose to develop this portion of its TSDF rulemaking first to prevent uncontrolled air emissions from land disposal restriction (LDR) treatment technologies. The technologies used in lieu of land disposal include the distillation/ separation processes subject to the Phase I rules. Publication of today's final rules for air emissions from hazardous waste management unit process vents from distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping processes and from leaks in piping and associated equipment handling hazardous wastes marks the completion of this first phase.

In the second phase, EPA will propose (in 1990) additional standards under section 3004(n) to control organic air emissions from other significant TSDF air emission sources not covered or not adequately controlled by existing standards. These sources include surface impoundments, tanks (including vents on closed, vented tanks), containers, and miscellaneous units.

The analyses of impacts indicate that, at some facilities, residual cancer risk to the most exposed individuals after implementing the first two phases of regulation will remain outside the risk range for other regulations promulgated under RCRA (which historically has been in the range of $1 \times 10^{-4}$ to $1 \times 10^{-6}$). The EPA is therefore planning a third phase of the effort to control TSDF emissions in which various means for further reducing risk will be examined. In the interim, as explained in section VI.E, the omnibus permitting authority of RCRA is an available option for requiring additional emission and risk reductions beyond that achieved by today's final rules if it is decided, on a case-by-case basis, that additional control is needed to protect human health and the environment.

The EPA is currently involved in an effort to improve the data used in the current risk analyses and, in the third phase, will make use of any new data obtained. If additional constituent control is found to be necessary, the number of constituents for which additional control is needed is expected to be significantly less than if a constituent approach were used as the only means of regulating TSDF air emissions. Therefore, the EPA is convinced that the control of organics as a class followed by controls for individual toxic constituents, as necessary, will ultimately result in comprehensive standards that are protective while providing effective interim control.

Should additional regulation under Phase III be necessary, EPA is considering a variety of approaches for reducing residual risk associated with emissions from wastes managed at TSDF, and additional approaches may be developed in the future. For example, EPA could require additional technology control for toxic waste management (e.g., technology that ensures lower rates of leakage from equipment, if such technology can be developed for use at TSDF) or limit the quantities of specific constituents that can be managed at a TSDF. The constituents to be evaluated in Phase III will include those reported as being present in hazardous wastes managed by existing TSDF for which health effects have been established through the development of unit risk factors for carcinogens and reference doses for noncarcinogens.

### *D. Other RCRA Air Standards*

The EPA has promulgated several standards under RCRA that reduce air emissions from TSDF. For example, several existing provisions in 40 CFR part 264 (40 CFR 264.251(f), 264.301(i), and 264.273(f)) require the implementation of general design and operating practices at permitted wastepiles, landfills, and land treatment operations to limit the release of particulate air emissions. The EPA has prepared a technical guidance document to aid in the implementation of these particulate rules; the document ("Hazardous Waste TSDF—Fugitive Particulate Matter Air Emissions Guidance Document," EPA–450/3–89–019) provides information on the sources of, and control technology for, particulate air emissions at TSDF. Additionally, 40 CFR part 264, subpart X, contains provisions that require prevention of air releases that may have adverse effects on human health or the environment at miscellaneous hazardous waste management units.

Air standards also have been promulgated for the control of air emissions from permitted hazardous waste incinerators (40 CFR part 264, subpart O). These standards require that incinerators be operated to achieve a destruction and removal efficiency (DRE) of at least 99.99 percent for those primary organic hazardous constituents listed in the facility permit. Higher efficiencies are required when the incinerator is burning certain specified waste types. These standards also limit air emissions of organics, hydrochloric acid, and particulates from incinerator stacks.

Air standards for interim status hazardous waste incinerators (40 CFR 265, subpart O) require monitoring of visible emissions and operating conditions. When burning specified wastes, these incinerators must receive a certification from the Assistant Administrator stating that the incinerator can meet the performance standards specified for permitted incinerators in 40 CFR 264, subpart O.

Interim status standards for other thermal treatment units are found in 40 CFR part 265, subpart P. These standards apply to facilities that thermally treat hazardous waste in devices other than enclosed devices using controlled flame combustion. The standards require monitoring of visible emissions and operating conditions of the combustion devices and prohibit open burning except for open burning and detonation of waste explosives.

The EPA has also proposed standards covering the burning of hazardous waste in boilers and industrial furnaces (52 FR 16982; May 6, 1987). These standards would require such burning to achieve a DRE of 99.99 percent for each principal organic hazardous constituent identified in the facility permit. In addition, a DRE of 99.99 percent must be achieved when burning certain specified constituents. The proposed standards also have provisions for burning low-risk wastes that allow an owner or operator to demonstrate that the burning of hazardous waste will not result in significant adverse health effects. To qualify for the low-risk waste exemption, an owner or operator would have to use dispersion modeling to demonstrate that emissions of carcinogenic compounds would not result in off-site ground-level concentrations that pose a risk to the most exposed individual of greater than $1 \times 10^{5}$. For noncarcinogenic compounds, the dispersion modeling would demonstrate that the resulting air concentrations would not exceed the reference air concentration (RAC) of individual hazardous compounds. The proposed standards would also limit emissions of carbon monoxide, metals, and hydrochloric acid from boilers and furnaces burning hazardous wastes.

### *E. Relationship of Air Standards to Other Subtitle C Rules*

In addition to the air emission standards discussed above, EPA has ongoing programs that indirectly affect air emissions from hazardous waste. Today's rules are designed to complement other air standards under RCRA and the rules that might otherwise affect air emissions. Existing RCRA regulations that have the potential for affecting air emissions from hazardous waste TSDF include: (1) The LDR and (2) the corrective action program.

The LDR, developed under section 3004(*m*) of the HSWA, require that hazardous waste be treated to reduce concentrations of specific chemicals or hazardous properties to certain performance levels or by certain methods before the waste may be disposed of on land. Affected land disposal units include surface impoundments, wastepiles, landfills, and land treatment units. The EPA anticipates that LDR will substantially reduce the potential for air emissions from these land disposal sources. The first set of LDR, for certain dioxins and solvent-containing hazardous wastes, was promulgated on November 7, 1986 (51 FR 40572); the second set of restrictions, the "California list," was promulgated on July 8, 1987 (52 FR 25760); the "First Third" was promulgated on August 17, 1988 (53 FR 31138), and the "Second Third" on June 23, 1989 (54 FR 26597).

The treatment technologies evaluated under LDR for both wastewater and nonwastewater spent solvents include distillation and other separation processes subject to the requirements of the Phase I rules. Today's standards are designed to protect human health and the environment by reducing air emissions from technologies expected to be used to treat wastes prior to land disposal.

Under the authority of RCRA section 3004(u), EPA is developing rules to address releases of hazardous waste or hazardous constituents from solid waste management units (SWMU) that pose a threat to human health and the environment. Because this authority applies to contamination of soil, water, and air media, organic air emissions from SWMU at some TSDF would be addressed by the corrective action program EPA intends to propose under a separate rulemaking. The draft rules would establish health-based trigger levels measured at the TSDF boundary for determining whether further remedial studies are required to assess air emissions from a particular SWMU. Health-based cleanup standards would then be set for air emission levels that exceed acceptable health-based levels at the point at which actual exposure occurs. When such exposure is determined either through monitoring or modeling techniques, corrective action will be required to reduce such emissions at the point of compliance.

The corrective action program is designed to achieve site-specific solutions based on an examination of a particular TSDF and its environmental setting. It is not intended to set national standards that regulate organic air emissions from all TSDF. At sites where there are releases from SWMU to the atmosphere, organic emissions will be controlled based on site-specific exposure concerns. Furthermore, releases from the SWMU that contain hazardous solid wastes will also be subject to corrective action. Therefore, for air emissions, corrective action is in part designed to expeditiously address threats to human health and the environment that are identified prior to implementation of more comprehensive air emission standards. In addition, because corrective action can address a wider universe of SWMU, it will address, in some respects, exposure concerns that today's final standards do not address.

### *F. Relationship of Today's Final Standards to CERCLA*

The CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA), 42 U.S.C. 9601 et seq., authorizes EPA to undertake removal and remedial actions to clean up releases of hazardous substances, pollutants, or contaminants. Removal actions typically are immediate or expedited activities necessary to minimize exposure or danger to human health and the environment from the release of a hazardous substance, pollutant, or contaminant. Remedial actions are longer term, planned activities performed at sites listed on the National Priorities List to permanently clean up hazardous substances, pollutants, or contaminants and any soils, surface waters, or ground waters contaminated by these materials. On-site remedial actions are required by CERCLA section 121(d)(2) to comply with the requirements of Federal and more stringent State public health and environmental laws that have been identified by EPA or the delegated State authority as applicable or relevant and appropriate requirements (ARAR) to the specific CERCLA site. In addition, the National Contingency Plan (NCP) provides that on-site CERCLA removal actions "should comply with Federal ARAR to the extent practicable considering the exigencies of the circumstances" (40 CFR 300.65(f)). Today's final standards may be considered ARAR for certain on-site remedial and removal actions.

A requirement under a Federal or State environmental law may either be "applicable" or "relevant and appropriate," but not both, to a remedial or removal action conducted at a CERCLA site. "Applicable requirements," as defined in the proposed revisions to the NCP, means those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site (40 CFR 300.5 (proposed), 53 FR 51475 (December 21, 1988)). "Relevant and appropriate requirements" means those Federal or State requirements that, while not applicable, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site (53 FR 51478).

Some waste management activities used for remedial and removal actions to clean up hazardous organic substances use the distillation/separation operations regulated under subpart AA of today's rules. For example, hazardous organic liquid wastes and ground and surface waters contaminated with hazardous wastes may be treated on site using air stripping processes. Therefore, the organic emission control requirements of today's subpart AA rules may be "applicable" for on-site remedial and removal action activities that use distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations that treat substances that are identified or listed under RCRA as hazardous wastes and have a total organic concentration of 10 ppmw or greater. In addition, off-site storage, treatment, and disposal of all wastes classified under RCRA as hazardous waste must be performed at a TSDF permitted under RCRA subtitle C. Thus, CERCLA wastes that are defined as hazardous under RCRA, contain more than 10 ppmw of total organics, and are shipped off site for management in distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping operations, would be subject to today's final standards like any similar RCRA hazardous waste. The new subpart AA control requirements for process vents may also be "relevant and appropriate" to on-site CERCLA removal and remedial actions that use distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping operations to manage substances that contain organics that are not covered by this rule (e.g., organics less than 10 ppmw or organics from nonhazardous wastes).

Today's final rules do not include control requirements for process vents on operations not associated with organics distillation/separation but typically associated with CERCLA remedial or removal actions such as soil excavation, in situ soil vapor extraction, in situ steam stripping of soil, soil washing, stabilization, bioremediation (in situ or otherwise), dechlorination, and low temperature thermal desorption. Therefore, the final rule for process vents would not be "applicable" to remedial or removal actions involving these processes at CERCLA sites. Also, the final process vent standards may not be considered "relevant and appropriate" for these same activities at CERCLA sites. Waste management operations involving soil excavation, in situ soil vapor extraction, in situ steam stripping of soil, soil washing, bioremediation, dechlorination, and low temperature thermal desorption can be considerably different from the waste management operations (i.e., distillation/separation processes) regulated in subpart AA. Control technologies for reducing organic emissions from these types of processes were not evaluated as part of today's rulemaking. However, the air emission potential of remedial and removal actions requiring excavation, land treatment, land farming, in situ treatment activities, and other treatment activities involving landfills and wastepiles should be determined, and, if necessary, the proper emission controls should be applied to these activities.

The organic emission control requirements of subpart BB for TSDF equipment leaks may also be considered as an ARAR for the equipment components (e.g., pumps and valves) installed at CERCLA cleanup sites that contain or contact substances containing 10 percent by weight or more total organics.

Although today's final standards would not be ARAR for all types of remedial and removal actions that are potential sources of organic air emissions, other existing RCRA or CAA regulations may qualify as ARAR for many of these activities. For example, subpart O of 40 CFR part 264 establishes standards of performance limiting organic emissions from thermal destruction processes (i.e., hazardous waste incinerators).

## IV. Applicability and Requirements of Proposed Process Vent and Equipment Leak Standards

On February 5, 1987 (52 FR 3748), EPA proposed standards under RCRA section 3004(n) for the control of organic air emissions from certain equipment and process vents at hazardous waste TSDF. The proposed standards would have applied to equipment and process vents "in volatile hazardous air pollutant (VHAP) service" (i.e., containing or contacting liquids, gases, or other derivatives of hazardous waste in concentrations greater than 10 percent total organics) located at TSDF required to have a RCRA permit. The decision as to whether equipment or process vents would be covered by the rule (i.e., would ever contain or contact wastes greater than 10 percent total organics) could be based either on testing the waste and derivatives according to specified test procedures or on engineering judgment as to these materials, total organic content.

The proposed standards would have required a 95-percent reduction in organic emissions from vents in VHAP service on product accumulator vessels and on other process vent sources (e.g., vents on closed accumulator tanks on other processes). The preamble for the proposed standard, at 52 FR 3753, described "product accumulator vessels" as types of equipment that generate process emissions and include distillate receivers, surge control vessels, product separators, or hot-wells that are vented to the atmosphere either directly or through a vacuum-producing system. Product accumulator vessels included units used to distill and steam or air strip volatile components from hazardous waste; examples include distillation columns, steam stripping columns, air stripping units, and thin-film evaporation units at TSDF.

The proposed standards would have regulated actual reclamation processes for the first time. Only recycling units at TSDF already subject to RCRA permit requirements (e.g., because of storage activity on the facility) would have been subject to the proposed air standards. Both new and existing units would have been required to have add-on control devices designed to achieve a 95-percent reduction (based on the application of secondary condensers) and to operate within that design. Once in operation, the facilities would have demonstrated compliance by monitoring the operation of the control device.

The proposed standards also would have required implementation of a monthly leak detection and repair (LDAR) program for valves, pumps, compressors, pressure relief devices, and closed-vent systems used to handle hazardous wastes and their derivatives at TSDF. Control systems, leak definition methodology, leak definitions, and repair schedules were based on existing equipment leak standards developed under sections 111 and 112 of the CAA.

Since proposal, EPA has made several important changes to the standards based on the public comments received after proposal and analyses resulting from these comments. The applicability and requirements of the final standards, including the changes made since proposal, are discussed in section V. The EPA's responses to the major comments are summarized in section VI. Additional information is presented in the BID for the final standards.

## V. Applicability and Requirements of Today's Final Standards

This section provides a detailed summary of the final standards as they apply to the affected TSDF community and to process vents and equipment subject to today's rule. Also summarized is the relationship of the final standards to existing exemptions under the RCRA regulatory program.

### *A. Scope of Final Standards*

Today's final standards limit organic air emissions as a class at TSDF that are subject to regulation under subtitle C of RCRA. This action is the first part of a multiphased regulatory effort to control air emissions at new and existing hazardous waste TSDF. These rules establish final standards limiting organic emissions from (1) process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping operations that manage hazardous wastes with 10 ppmw or greater total organics concentration on an annual average basis, and (2) leaks from equipment that contain or contact hazardous waste streams with 10 percent by weight or greater total organics.

The final standards do not expand the RCRA-permitted community for the purposes of air emissions control. As promulgated, the final standards control organic emissions only from process vents and equipment leaks at hazardous waste TSDF that are subject to permitting requirements under RCRA section 3005 and are applicable only to specific hazardous waste management units. The rules apply to hazardous waste management units that are subject to the permitting requirements of part 270 and to hazardous waste recycling units that are located at facilities otherwise subject to the permitting requirements of part 270. Exempt units, other than recycling units (e.g., 90-day accumulation tanks and wastewater treatment units as specified in § 270.1(c)(2)), are not subject to the rules even when they are part of a permitted facility. Permitting aspects are further discussed in section IX.

The term "organics" is used in the final standards instead of "volatile organics" to avoid confusion with "volatile organic compounds" (VOC) that are regulated as a class under the CAA. To be subject to the standards, a TSDF: (1) Must have equipment that contains or contacts hazardous wastes that are 10 percent or more by weight total organics, or (2) must have distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations that treat or process hazardous wastes with total organics concentrations of 10 ppmw or greater on a time-weighted annual average basis.

The final regulations require the facility owners or operators to determine whether their equipment is subject to the equipment leak rules, subpart BB of parts 264 and 265. The owner or operator of a facility may rely on engineering judgment for this determination, or, if the waste's organic content is questionable, the owner or operator may choose any of the test methods identified in the final rule for determining whether a piece of equipment contains or contacts hazardous wastes that are 10 percent or more total organics by weight. As proposed, these methods include: ASTM Methods D–2267–88, E 169–87, E 168–88, and E 260–85 and Methods 9060 and 8240 of SW–846. The owner or operator also may use any other test method for determining total organic content that is demonstrated to be equivalent to the test methods identified in the rule using the petition process described in 40 CFR 260.21. The test method selected should be the one best suited for the characteristics of the waste stream. Regardless of the method chosen, the final standard requires the facility owner or operator to determine that the organic content is never expected to exceed 10 percent. The determination of organic content of the waste must at all times be appropriate to the wastes currently being managed in the relevant units. If any action is taken that would result in the determination no longer being appropriate to the facility's or a particular unit's operations (e.g., an upstream process change that results in a change in a waste's organic content), then a new determination is required.

To determine whether a particular hazardous waste management unit of the type specified in the rule (e.g., a steam stripping or air stripping unit) is subject to the provisions of subpart AA of parts 264 and 265, the owner/operator is required to determine the total organic concentration of the waste managed in the unit initially (by the effective date of the standards or when the waste is first managed in the waste management unit) and thereafter on a periodic basis (for continuously generated wastes). A waste determination for subpart AA applicability would not be necessary when an owner/operator manages the waste in a distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping unit that is controlled for organic emissions and meets the substantive requirements of subpart AA.

Determination that the time-weighted, annual average total organic concentration of the waste managed in the unit is less than 10 ppmw must be performed by direct measurement or by knowledge of the waste as described later in this section. Direct measurement of the waste's total organic concentration must be performed by collecting individual grab samples of the waste and analyzing the samples using one of the approved reference methods identified in the rule.

The EPA is requiring that analytical results for a minimum of four samples be used to determine the total organic concentration for each waste stream managed in the unit. In setting the minimum number of samples at four, EPA will obtain sufficient data to characterize the total organic concentration of a waste without imposing an unnecessary burden on the owner/operator to collect and analyze the samples.

Waste determinations must be performed under process conditions expected to result in the maximum waste organic concentration. For waste generated on site, the samples must be collected at a point before the waste is exposed to the atmosphere such as in an enclosed pipe or other closed system that is used to transfer the waste after generation to the first affected distillation/separation operation. For waste generated off site, the samples must be collected at the inlet to the first waste management unit that receives the waste, provided the waste has been transferred to the facility in a closed system such as a tank truck, and the waste is not diluted or mixed with other waste.

The location where the waste's total organic content is determined is important because sampling location can greatly affect the results of the determination. This effect occurs because the concentration level can decrease significantly after generation as the waste is transferred to (and managed in) various waste management units.

If the waste is directly or indirectly exposed to ambient air at any point, a portion of the organics in the waste will be emitted to the atmosphere, and the concentration of organics remaining in the waste will decrease. For example, for highly volatile organic compounds such as butadiene, all of the compound would evaporate within a few seconds of exposure to air. To ensure that the determination of total organic concentration is an accurate representation of the emission potential of a waste upon generation, it is essential that the waste determination be performed at a point as near as possible to where the waste is generated, before any exposure to the atmosphere can occur.

For the reasons stated above, the waste determination must be based on the waste composition before the waste is exposed, either directly or indirectly, to the ambient air. Direct exposure of the waste to the ambient air means the waste surface interfaces with the ambient air. Indirect exposure of the waste to the ambient air means the waste surface interfaces with a gas stream that subsequently is emitted to the ambient air. If the waste determination is performed using direct measurement, the standards would require that waste samples be collected from an enclosed pipe or other closed system that is used to transfer the waste after generation to the first hazardous waste management unit. If the waste determination is performed using knowledge of the waste, the standards would require that the owner or operator have documentation attesting to the organic concentration of the waste before any exposure to the ambient air.

The location where the waste determination would be made for any one facility will depend on several factors. One factor is whether the waste is generated and managed at the same site or generated at one site and transferred to a commercial TSDF for management. Another important factor is the mechanism used to transfer the waste from the location where the waste is generated to the location of the first waste management unit (e.g., pipeline, sewer, tank truck). For example, if a waste is first accumulated in a tank using a direct, enclosed pipeline to transfer the waste from its generation process, then the waste determination could be made based on waste samples collected at the inlet to the tank. In contrast, if the waste is first accumulated in a tank using an open sewer system to transfer the waste from its generation process then the waste determination would need to be made based on waste samples collected at the point where the waste enters the sewer before the waste is exposed to the ambient air. Where the waste is generated off site, the owner or operator may make the determination based on samples collected at the inlet to the first waste management unit at the TSDF that receives the waste, provided the waste has been transferred to the TSDF in a closed system such as a tank truck and the waste is not diluted or mixed with other waste. If a waste determination indicates that the total organic concentration is equal to or greater than the applicability criterion, then the owner or operator would be required to comply with the standards.

As an alternative to using direct measurement, an owner/operator is allowed to use knowledge of the waste as a means of determining that the total organic concentration of the waste is less than 10 ppmw. Examples of information that might be considered by EPA to constitute sufficient knowledge include: (1) Documentation that organics are not involved in the process generating the waste, (2) documentation that the waste is generated by a process that is identical to a process at the same or another facility that has previously been determined by direct measurement to generate a waste stream having a total organic content less than 10 ppmw, or (3) previous speciation analysis results from which the total concentration of organics in the waste can be computed and it can be documented that no process changes have occurred since the analysis that could affect the waste's total organic concentration. The final standards include the provision that EPA can require that the waste be analyzed using Method 8240 if EPA believes that the documentation is insufficient to determine an exception by knowledge of the waste (§§ 264.1034(f) and 265.1034(f)).

To address the temporal variability that can occur both within a particular waste stream and within the various waste streams managed in a hazardous waste management unit, the final rules require a time-weighted, annual average concentration to characterize the waste managed in the unit. The final rules require that an owner/operator repeat the waste determination whenever there is a change in the waste being managed or a change in the process that generates or treats the waste that may affect the regulatory status of the waste or, if the waste and process remain constant, at least annually. For example, continuous processes are more likely to generate a more homogeneous waste than batch operations: batch operations involve processes that may frequently involve change in materials or process conditions. Batch operations, therefore, usually generate wastes with varying characteristics, including such characteristics as organics content. Ground water concentrations would also be expected to show significant variation if more than one well provides influent to a waste management unit such as an air stripper and the wells that feed the unit are varied over time or if the proportions from the wells that make up the influent are changed. This is because there is typically considerable spatial variability in contaminated ground water concentrations. The situation where feed wells are changed and the change is not accounted for in the initial waste determination would be considered a process change or change in the waste being managed that would require a new determination.

With the time-weighted, annual average applicability criterion, a hazardous waste management unit would not be subject to this rule if it occasionally treats wastes that exceed 10 ppmw if at other times the wastes being treated in the unit are such that the weighted annual average total organic concentration of all wastes treated is less than 10 ppmw. The time-weighted, annual average is calculated using the annual quantity of each waste stream managed in the unit and the mean organic concentration of each waste stream.

Determining the applicability of the standards to affected processes, units, and facilities is of paramount importance to the TSDF owner or operator in complying with the final standards. A mistake even an inadvertent one, will not excuse a facility owner or operator from the obligation to comply with either the requirements of the standards or with potential enforcement actions. Accurate determinations of what equipment and vents must be controlled are crucial to ensuring that all equipment and vents subject to this rule are in fact controlled. When the facility owner/operator and the Regional Administrator disagree on the determination of emissions or emission reduction achieved, then a performance test conducted as specified in the rules must be used to resolve the disagreement. In situations where the owner/operator and Regional Administrator disagree on whether a unit manages a waste with 10 ppmw or greater organics content or a piece of equipment contains or contacts a waste with 10 percent or more organics content, then procedures that conform to the test methods referenced in the rules may be used to resolve the disagreement.

Consistent with section 3010 of RCRA, the final standards for process vent and equipment leak control and monitoring become effective 6 months from today. Owners and operators must come into compliance with these requirements by the effective date; however, where compliance involves the installation of a control device, EPA is requiring that installation be completed as soon as possible but no later than 24 months from the date the regulatory action affecting the unit is published or promulgated. To obtain the extended time for compliance (18 months beyond the effective date), a facility must show that installation cannot reasonably be expected to be completed earlier. In these circumstances, an owner/operator must develop an implementation schedule that indicates when the installation will be completed and shows that additional time is necessary. The implementation schedule must be included in the operating record by the effective date of the rules. Changes in the implementation schedule are allowed within the 24-month time frame if the owner/operator documents that the change cannot reasonably be avoided.

### *B. Standards for Process Vents*

#### Affected Equipment

A "process vent" is a pipe, stack, or other opening through which emissions from a hazardous waste management unit are released to the atmosphere either directly, through a vacuum-producing system, or indirectly, through another tank. The process vents that would have been covered by the proposed standard included vents associated with any hazardous waste management process or waste management unit.

Review of the hazardous waste TSDF industry has shown that process vents are most typically associated with processes related to distillation or other separation operations. These technologies were also the type being evaluated under the LDR for spent solvents. Therefore EPA concentrated its analysis of process vents on those hazardous waste management units that are involved in solvent or other organic chemical separation or reclamation by distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations. This should include the largest segment of process vents at TSDF and address those sources with the greatest emission potential. Vents on other types of waste management units (e.g. vents on storage tanks) are being addressed in the Phase II rulemaking.

Two basic changes have been made since proposal that clarify the applicability of the final vent standard. First, to avoid confusion with tanks not associated with the processing of waste streams, the term "product accumulator vessel" has been deleted from the final standard and affected equipment is more specifically defined. The applicability of the final standard for process vents also has been clarified since proposal to exclude air emissions from vents on other closed (covered) and vented tanks not associated with the specified distillation/separation processes to avoid regulatory duplication of the Phase II standards as discussed above.

Thus, the final vent standards apply to: (1) Vents on distillation fractionation, thin-film evaporation, solvent extraction, and air or steam stripping processes and vents on condensers serving these processes; and (2) vents on tanks (e.g., distillate receivers, bottoms receivers, surge control tanks, separator tanks, and hot wells associated with distillation, fractionation, thin-film evaporation, solvent extraction, and air or steam stripping processes) if emissions from these processes are vented through the tank. For example, *uncondensed overhead* emitted from a distillate receiver (which fits the definition of a tank) serving a hazardous waste distillation process unit is subject to these Phase I air controls. On the other hand, emissions from vents on tanks or containers that do not derive from a process unit specified above are not covered by these rules. For example, if the condensed (recovered) solvent is pumped to an intermediate holding tank following the distillate receiver mentioned in the above example, and the intermediate storage tank has a pressure-relief vent (e.g., a conservation vent) serving the tank, this vent will not be subject to the process vent standards. Emissions from vents that are not covered under today's rules will be addressed by Phase II of the air standards under section 3004(n).

Second, the terms "VHAP" and "in VHAP service" have been deleted from the final rule in response to public comments. Commenters found the terms inappropriate for transfer from equipment leak standards developed under section 111 or 112 of the CAA to RCRA standards for organic emissions from hazardous waste. The EPA agrees with these commenters; these terms can be confusing and they are unnecessary for these rules. Therefore, the cross-reference to part 61 has been eliminated and the wording of the final regulation has been revised to reflect applicability based on clearly specified hazardous waste management processes or unit operations that manage wastes with a 10 ppmw or greater total organic content.

### Requirements of Final Standard for Process Vents

In response to public comments, several changes have been made to the proposed standard for process vents. While the proposed 95-percent emission reduction standard would have applied to individual process vents emitting organics with concentrations of 10 percent or greater by weight, the final process vent 95-percent emission reduction standard applies to total organic emissions from the combination of all affected vents (i.e., vents subject to the provisions of subpart AA) at the facility. As discussed in section VI of this preamble and in the BID for the final rules, the term "facility" refers to the entire site that is under control of the owner or operator engaged in hazardous waste management. Thus, organic emissions from affected process vents anywhere on the hazardous waste management facility are subject to the standards.

The 10-percent concentration criterion for process vents has not been included in the final rules because the promulgated standards contain a facility-based emission rate limit of 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 ton/yr) that is more effective in controlling emissions from affected sources and excluding facilities with little emission reduction potential. Based on emissions and health risk analyses conducted in response to comments, this emission rate limit represents an emission level from process vents that is protective of human health and the environment and below which additional meaningful reductions in nationwide health risk and environmental impacts attributable to process vents cannot be achieved. Control of facilities with process vent emissions less than the emission rate limit would not result in further reductions of either cancer risk or incidence on a nationwide basis. Facilities with organic emissions from process vents that do not exceed these emission rates will not have to install controls or monitor emissions from affected process vents. Selection of the emission rate limit is addressed in section VI.B of this preamble and in chapters 4.0 and 7.0 of the BID.

Because the emission rate limits (3 lb/h and 3.1 ton/yr) provide health-based limits, EPA considered dropping completely the organic content criterion (i.e., at least 10 percent total organics). However, EPA decided not to completely eliminate the organic content criterion because it is not clear that the same controls can be applied to very low concentration streams as can be applied to the higher concentration streams that generally are associated with emission rates greater than the limits. For low-concentration streams, EPA questions whether controls are needed on a national or generic basis but is unable to resolve this question at this time. Thus, EPA decided to defer controlling very low concentration streams until it is better able to characterize and assess these streams and the appropriate controls.

Once EPA decided to consider facilities that manage very low concentration organic wastes as a separate category, there remained the problem of determining the appropriate criterion. The EPA examined existing data on air strippers, the treatment device most commonly used with low-concentration streams; it appeared that the quantity of emissions and the risk associated with air strippers treating streams with concentrations below 10 ppmw may be relatively small, thus minimizing the potential harm of deferring control until a later time. Examples of facilities managing low-concentration wastes are sites where ground water is undergoing remedial action under CERCLA or corrective action pursuant to RCRA. Given the limited set of precise data available, and the comments that the 10-percent criterion was too high, EPA determined that an appropriate criterion would be 10 parts per million (ppm) total organics in the waste by weight.

The 10-ppmw criterion is not an exemption from regulation; it is intended only as a way for EPA to divide the air regulations into phases. The EPA is deferring action on very low concentration streams (i.e., ones with less than 10 ppmw total organic content) from the final rule today but will evaluate and announce a decision later on whether to regulate these waste streams.

To comply with the final standards for process vents, the TSDF owner or operator is required to identify all process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, and stripping processes that are treating hazardous waste with a 10-ppmw or greater total organics concentration on a time-weighted annual average basis (i.e., vents affected by the rules). Organic emission rates for each affected vent and for the entire facility from all affected vents must be determined. The facility process vent emission rate must then be compared to the short- and long-term process vent emission rate limits (3 lb/h or 3.1 ton/yr) to determine whether additional emission controls are required. If the process vent emission rate limit is exceeded, the owner or operator must take appropriate action to reduce total facility emissions from affected process vents to below the cutoff level or install additional emission controls to reduce total facility process vent organic emissions by 95 weight percent. If an incinerator, process heater, or boiler is used as a control device, the volume concentration standard of 20 ppmv can be met instead of the 95-weight-percent reduction (§§ 264.1033(c), 264.1060, 265.1033(c), and 265.1060).

Because the final rules could apply to dilute process vent streams and the rule is formatted in terms of a weight-percent reduction standard, it is necessary to include the volume concentration standard in the final control device standards to account for the technological limitations of enclosed combustion devices (48 FR 48933, October 21, 1983), one of the control technologies examined as part of the rulemaking, treating dilute streams. Below a critical concentration level, the maximum achievable efficiency for enclosed combustion devices decreases as inlet concentration decreases; thus, for streams with low organic vapor concentrations, the 95-percent mass reduction may not be technologically achievable in all cases. Available data show that 20 ppmv is the lowest outlet concentration of total organic compounds achievable with control device inlet streams below approximately 2,000 ppmv total organics. Therefore, a concentration limit of 20 ppmv has been added as an alternative standard for incinerators, process heaters, and boilers to allow for the drop in achievable destruction efficiency with decreasing inlet organics concentration. For consistency, the 20-ppmv concentration is expressed as the sum of the actual individual compounds, not carbon equivalents, on a dry basis corrected to 3 percent oxygen. For facilities that do not meet the emission rate limit, the final process vent standards require that control devices achieve a 95-percent reduction in total organic emissions for the facility or, in the case of enclosed combustion devices, a reduction of each process vent stream to a concentration of no more than each process vent stream to a concentration of no more than 20 ppmv total organic compounds.

The final standards for process vents do not require the use of any specific equipment or add-on control device; the standards can be met using several types of controls. Depending on the characteristics of the process vent stream, either a condenser or a carbon adsorber will likely be the control technology of choice. However, other control devices such as flares, incinerators, process heaters, and boilers, as well as any other device of the owner or operator's choice, also can be used where applicable to achieve compliance.

Operating requirements for closed-vent systems and control devices are included in §§ 264.1033 and 265.1033. A closed-vent system means a system not open to the atmosphere and composed of piping, connections, and, if necessary, flow-inducing devices that transport gas or vapor from a piece or pieces of equipment to a control device. If vapor recovery systems such as condensers and adsorbers are used as control devices, they must be designed and operated to recover the organic vapors vented to them with an efficiency of 95 percent or more unless the total organic emission limits for affected process vents (§§ 264.1032 and 265.1032) can be attained at efficiencies less than 95 percent. Vapor recovery systems whose primary function is the recovery of organics for commercial or industrial use or reuse (e.g., a primary condenser on a waste solvent distillation unit) are not considered a control device and should not be included in the 95-percent emission reduction determination.

If enclosed combustion devices such as incinerators, boilers, or process heaters are used, they must be designed and operated to achieve a total organic compound emission reduction efficiency of 95 percent or more or must provide a minimum residence time of 0.5 s at a minimum temperature of 760 °C. The latter are general design criteria established by EPA, and used in numerous rulemakings, that can be used by facilities in lieu of conducting a site-specific design for enclosed combustion devices. The operating requirements for closed-vent systems and control devices include a provision allowing enclosed combustion devices to reduce organic emissions to a total organic compound concentration of 20 ppmv, by compound, rather than achieve the 95-weight percent reduction.

If flares are used, they must be designed and operated with no visible emissions as determined by the procedures of Reference Method 22, except for periods not to exceed a total of 5 min during any 2 consecutive hours. The final standard specifies that flares must be operated with a flame present at all times and must be operated at all times when emissions may be vented to them. In addition, flares must provide a net heating value of the gas being combusted of 11.2 megajoules per standard cubic meter (MJ/scm) or more, be steam-assisted or air-assisted, or provide a net heating value of 7.45 MJ/scm or more if the flare is nonassisted. Specific design and operating requirements for steam-assisted, air-assisted and nonassisted flares also are included in the final standard. Calculations and procedures for determining the net heating value of the gas being combusted the actual exit velocity and the maximum allowed velocity are included in the final provisions for closed-vent systems and control devices (see §§ 264.1033(d) and 265.1033(d)).

Facilities must maintain documentation in the operating record supporting waste determinations, identifying affected process vents, affected waste management unit throughputs and operating hours, emission rates for each affected vent and for the overall facility, and the basis for determining the emission rates (§§ 264.1035(b)(2) and 265.1035(b)(2)). Regardless of the type of control device used, the documentation must certify that add-on control devices achieve the emission rate limit by design and during operation, or that add-on control devices achieve a 95-percent reduction in organics or achieve the 20-ppmv organics concentration limit by design and during operation where the emission rate limit is not attained. The design documentation must present the basis for determining the design emission reduction and establish the basic values for operating parameters used to monitor the control device's operation and maintenance. The design control level (i.e., the emission reduction needed to achieve the emission rate cutoff or 95-percent emission reduction) can be documented by vendor/manufacturer certifications, by engineering calculations, or through source tests to show that the control device removes the required percentage of organics entering the device. All required information and documentation must be kept in the facility's operating record. The facility's waste determinations and process vent emission rate determinations must at all times reflect the facility's current waste management unit designs and wastes managed. If the owner/ operator takes any action that would result in the determination no longer being appropriate to the facility's operations (e.g., if a waste of different composition is managed, the operating hours of the affected management units are increased beyond what was originally considered, or a new affected unit is added that may impact its regulatory status), then a new determination is required (§§ 264.1035(b)(2)(ii) and 265.1035(b)(2)(ii)). In addition, certain information regarding the facility's emission determination and control device design must be included in the facility's part B permit application.

The final rules require the continuous monitoring of specific parameters on all control devices needed to meet the standards to ensure that the devices perform according to their design (§§ 264.1033(f) and 265.1033(f)). The final rules clarify the general parameters listed in the proposal by describing the requirements in greater detail. Operating parameters are specified for condensers, carbon adsorbers, flares, incinerators, and other enclosed combustion devices. Although minimum operating conditions are identified for organic vapor destruction devices (e.g., incinerators and flares) to ensure 95-percent destruction, values or ranges of values for recovery device (i.e., condensers and carbon adsorbers) operating parameters cannot be specified on an industry-wide basis. Therefore, a recovery device must be designed for the particular application and monitored to ensure that it is being operated within design specifications. Proper design shall be determined through engineering calculations vendor certification, and/or emission testing.

The owner/operator is required to record the control device monitoring information, including the basis for the operating parameters used to monitor control device performance, in the facility operating record. Periods when monitoring indicates control device operating parameters are outside established tolerances on design specifications must be recorded. Facilities with final permits incorporating these standards (i.e., facilities subject to the provisions of 40 CFR part 264 subpart AA) must report exceedances that are not corrected within 24 hours to the Regional Administrator on a semiannual basis. The records and reports must include the dates, duration, cause, and corrective measures taken. (See §§ 264.1036(a) and 264.1065(a)(4).)

The specific monitoring requirements for control device operating parameters include: (1) Continuous monitoring of coolant fluid temperature and exhaust gas temperatures or the concentration level of organic compounds in the exit gas stream for condensers; (2) continuous monitoring of exhaust gas organic breakthrough for carbon adsorbers; (3) continuous monitoring of combustion zone temperature for incinerators, boilers and process heaters; and (4) the presence of a pilot flame using a thermocouple or any other equivalent device to detect the presence of a flame for flares.

The final standards would require that emission control equipment is properly designed, installed, operated, and maintained. Also, as previously described, the standards would require continuous monitoring of specific control device operating parameters. A control device monitor reading outside the operating range allowed by the standards (referred to in this preamble as a "control device exceedance") indicates that the control device is not operating normally or is malfunctioning (i.e., not operating at the design setting necessary to achieve at least 95 percent organic emission control efficiency). Action must be taken by the owner or operator to return the control device to operating at the design setting. When a control device exceedance cannot be corrected within 24 hours of detection, the final standards would require the owner or operator to record specific information concerning the control device exceedance. Facilities with final RCRA permits must report this information to EPA on a semiannual basis; interim status facilities are not required to report control device exceedances. The exceedance report would need to describe the nature and period of each control device exceedance and to explain why the control device could not be returned to normal operation within 24 hours. A report would need to be submitted to EPA only if control device exceedances have occurred during the past 6-month reporting period. These reports would serve to aid EPA in determining the owner's or operator's ability to properly operate and maintain the control device. The EPA recognizes that a control device malfunction may occur due to circumstances beyond the control of the owner or operator (e.g., defective equipment supplied by the manufacturer). Therefore, a single control device exceedance may not necessarily be indicative of improper control device operation or maintenance.

### *C. Equipment Leak Standards*

#### Affected Equipment

The final standards apply to each valve, pump, compressor, pressure relief device, open-ended valve or line, flange or other connector, and associated air emission control device or system that contains or contacts hazardous waste streams with 10 percent or more total organics by weight.

In response to public comments, EPA has changed the applicability of the final LDAR standards for pumps and valves to better relate to the volatility of the wastes managed and thus to air emission potential. The requirements for pumps and valves have been revised to include the heavy liquid provisions contained in EPA's new source performance standard (NSPS) for equipment leaks of VOC in the synthetic organic chemicals manufacturing industry (SOCMI) (40 CFR part 60, part VV). The heavy liquid provisions (§§ 264.1058 and 265.1058) exempt pumps and valves processing lower vapor pressure substances from the routine leak-detection monitoring requirements of the standards. By their nature, heavy liquids exhibit much lower volatilities than do light liquids, and because equipment leak rates and emissions have been shown to vary with stream volatility, emissions from heavy liquids are less than those for lighter, more volatile streams. For example, EPA analyses indicate that emissions from valves in heavy liquid service are more than 30 times lower than the emissions from valves in light liquid service.

Pumps and valves are in light liquid service if the vapor pressure of one or more or the components being handled by the piece of equipment is greater than 0.3 kilopascal (kPa) at 20 °C, if the total concentration of the pure components having a vapor pressure greater than 0.3 kPa at 20 °C is equal to or greater than 20 percent by weight, and if the fluid is a liquid at operating conditions. Pumps and valves not in light liquid service are defined to be in heavy liquid service.

The regulations governing equipment leaks also have been incorporated and reprinted in the final standards to eliminate cross-referencing to part 61 regulations and to consolidate the requirements under RCRA.

#### Equipment Leak Control Requirements

The control requirements for valves are based on LDAR requirements. Valves in light liquid or gas/vapor service (§§ 264.1057 and 265.1057) must be monitored using Reference Method 21; an instrument reading at or above 10,000 ppm indicates the presence of a leak. If a leak is detected, the valve must be repaired as soon as practicable but no later than 15 days after the leak is detected. A first attempt to repair the valve must be made no later than 5 days after the leak is detected. First attempts at repair include, but are not limited to, tightening or replacing bonnet bolts tightening packing gland nuts, or injecting lubricant into the lubricated packing.

Monthly monitoring is required; however, any valve for which a leak is not detected for 2 successive months may be monitored the first month of each succeeding quarter until a leak is detected (§§ 264.1057(c) and 265.1057(c)). If a leak is detected the valve must be monitored monthly until a leak is not detected for 2 successive months.

In addition, monthly monitoring is not required if: (1) A leakless valve, such as a sealed-bellows valve, is used to achieve a no-detectable-emissions limit (500 ppm above background, as measured by Method 21, with an annual performance test; §§ 264.1057(f) and

265.1057(f); (2) the owner or operator meets a performance level of 2 percent of all valves leaking (§§ 264.1061 and 265.1061); (3) the owner or operator elects to comply with a skip-period leak detection and repair program as described for valves (§§ 264.1062 and 265.1062); or (4) the valve is designated by the owner or operator as unsafe-to-monitor or difficult-to-monitor (§§ 264.1057 (g) and (h) and 265.1057 (g) and (h)). A valve may be designated as unsafe-to-monitor if monitoring personnel would be exposed to an immediate danger as a consequence of monitoring and if the owner or operator adheres to a written plan that requires monitoring of the valve as frequently as practicable during safe-to-monitor times. A valve may be designated as difficult-to-monitor if the valve cannot be monitored without elevating monitoring personnel more than 2 m above a support surface, the valve is in an existing hazardous waste management unit and the owner or operator follows a written plan that requires monitoring at least once a year.

The EPA is continuing to study the status of new technology available for the control of air emissions from valves. The EPA has issued a separate notice in the **Federal Register** that discusses available information on leakless valve technology (54 FR 30228, July 19, 1989). Public comments were requested in that notice on several aspects of the technology to assist EPA in determining applications for which leakless valve technology would be appropriate at hazardous waste TSDF.

The final standards also require monitoring for pumps at TSDF containing or contacting wastes with greater than 10 percent organics (§§ 264.1052 and 265.1052). Each pump in light liquid service must be monitored monthly with a portable vapor analyzer following the EPA Reference Method 21 protocol. In addition, each pump in light liquid service must be checked weekly by visual inspection for indications of liquids dripping from the pump seal. A pump is determined to be leaking if an instrument reading of 10,000 ppm or greater is measured or there are indications of liquids dripping from the pump seal. When a leak is detected, it must be repaired as soon as practicable, but not later than 15 days after it is detected unless the delay-of-repair provisions specified in the rule apply. The first attempt at repair must be made within 5 calendar days of the leak being detected.

Pumps in light liquid service are exempt from the monitoring requirements under §§ 264.1052 (d) and (e) and 265.1052 (d) and (e) if: (1) The pump is equipped with a dual mechanical seal system that includes a barrier fluid between the two seals, (2) a magnetically coupled or diaphragm pump is used to achieve a no-detectable-emissions limit (indicated by a portable organic vapor analyzer reading of less than 500 ppm above background), or (3) the pump is equipped with a closed-vent system capable of transporting any leakage from the seal or seals to a 95-percent efficient control device. If pumps are equipped with a dual mechanical seal system, emissions from the barrier fluid reservoir must be vented to a control device designed and operated to achieve a 95-percent control efficiency, the barrier fluid must be purged and added to the hazardous waste stream, or the pressure of the barrier fluid must be maintained at a level above the pressure in the pump or exhauster stuffing box. A pressure or level indicator to detect any failure of the seal system or the barrier fluid system is required, with the indicator checked daily or equipped with an alarm to signal failure of the system. If leakless equipment is used, such as magnetically coupled or diaphragm pumps, the standards require an annual performance test by Method 21 to verify the no-detectable-emissions status of the equipment.

Compressors must be equipped with a seal system that includes a barrier fluid system that prevents leakage of organic emissions to the atmosphere. The seal system must be operated with the barrier fluid at a pressure that is greater than the compressor stuffing box pressure, be equipped with a barrier fluid system that is connected by a closed-vent system to a control device that meets the design and operating requirements established in §§ 264.1060 and 265.1060, or be equipped with a system that purges the barrier fluid into a hazardous waste stream with zero total organic emissions to the atmosphere. In addition, the barrier fluid system must be equipped with a sensor that detects failure of the seal system, barrier fluid system, or both. A compressor is determined to be leaking if the sensor indicates failure of the seal system, the barrier fluid system, or both. When a leak is detected, it must be repaired as soon as practicable, but not later than 15 calendar days after it is detected; a first attempt at repair must be made within 5 calendar days.

Except during emergency pressure releases, each pressure relief device in gas/vapor service must be operated with no detectable emissions (500 ppm above background, as measured by Reference Method 21) (§§ 264.1054 and 265.1054). No later than 5 calendar days after any pressure release, the device must be returned to a condition of no detectable emissions and be monitored to confirm that status. Any pressure relief device that is equipped with a closed-vent system capable of capturing and transporting leakage to a control device that meets the requirements of §§ 264.1060 and 265.1060 is exempt from these requirements.

Each open-ended valve or line must be equipped with a cap, blind flange, plug, or second valve (§§ 264.1056 and 265.1056). The cap, blind flange, plug, or second valve must seal the open end at all times except during operation requiring hazardous waste stream flow through the open-ended valve or line. Operational requirements for second valves and double block and bleed systems also are specified in the final regulation.

Pumps and valves in heavy-liquid service, pressure relief devices in light-liquid or heavy-liquid service, and flanges and other connectors must be monitored within 5 days by Reference Method 21 if evidence of a potential leak is found by visual, audible, olfactory, or any other detection method (§§ 264.1058 and 265.1058). A leak is detected if an instrument reading of 10,000 ppm or greater is measured. When a leak is detected, it shall be repaired as soon as practicable but not later than 15 calendar days after detection. The first attempt at repair must be made within 5 calendar days of the leak being detected.

The final standards also include provisions for delay of repair (§§ 264.1059 and 265.1059). Delay of repair of leaking equipment is allowed if the repair is technically infeasible without a hazardous waste management unit shutdown (i.e., a work practice or operational procedure that stops operation of a hazardous waste management unit or part of a hazardous waste management unit). However, repair of the leak must be performed before the end of the next shutdown of that unit. Delay of repair also is allowed for equipment (i.e., either pumps or valves) that is isolated from the hazardous waste management unit and is prevented from containing or contacting a hazardous waste with 10 percent or more organic content. For valves, delay of repair is allowed if: (1) The owner or operator determines that emissions of purged material resulting from immediate repair are greater than the emissions likely to result from delay of repair, and (2) when the valve is repaired the purged materials are collected and destroyed or recovered in a control device complying with the requirements of the standards. Delay of repair beyond a hazardous waste management unit shutdown is allowed only if valve assembly replacement is necessary during the next shutdown of the unit, valve assembly supplies have been depleted, and valve assembly supplies had been sufficiently stocked before supplies were depleted (i.e., the owner/operator has made a good-faith effort to maintain adequate spare parts). For pumps, delay of repair is allowed if: (1) Repair requires the use of a dual mechanical seal system that includes a barrier fluid system, and (2) repair is completed as soon as practicable, but not later than 6 months after the leak is detected.

The final standards also include design and operating requirements for closed-vent systems that may be used to comply with the equipment leak standards (§§ 264.1060 and 265.1060). Closed-vent systems must be designed for and operated with no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background by Reference Method 21. A leak on a closed-vent system, indicated by an instrument reading of 500 ppm or by visual inspection, must be repaired within 15 calendar days after detection; a first attempt at repair must be made no later than 5 calendar days after detection. Monitoring must be conducted initially, annually, and at other times as requested by the Regional Administrator, to confirm the no-detectable-emissions status of the system. Like other control devices, closed-vent systems must be operated at all times when any emissions may be vented to them.

The provisions of 40 CFR 61.244, subpart V, which provide a formal mechanism for applying for use of an alternative means of emission limitation, were specifically not included in the proposed TSDF process vent and equipment leak rules and have not been included in these final standards. The alternative means of emission limitation provisions are not considered self-implementing; i.e., these provisions cannot be satisfied without the need for detailed explanation or negotiation between the facility owner/operator and EPA, and thus are not appropriate as requirements for interim status facilities under part 265. Therefore, the alternative means of emission limitation provisions were not included in the final subpart AA and BB rules. An owner or operator, however, may use an alternative means of emission limitation to comply with the process vent or equipment leak standards of part 264. The owner/operator can use part B of the permit application to provide information that demonstrates the effectiveness of any alternative means of emission limitation and can use the negotiation process associated with issuance of a final permit to establish conditions for use of an alternative means of emission limitation. The owner or operator would be responsible for collecting and verifying test data to document that the emission reduction achieved by the alternative is equal to or greater than the emission reduction achieved by the equipment, design, or operational requirements in the standard.

Additional general recordkeeping requirements include information on pump, valve, compressor, and pressure relief device leak repair attempts; reasons for repair delays; and design criteria for sampling connection systems and closed-vent systems and control devices. There are also recordkeeping and monitoring requirements for pieces of equipment covered by alternative requirements.

Compliance with the equipment leak standards will be assessed through plant inspections and the review of records that document implementation of the requirements as required by the final standards.

### *D. Summary of Changes from Proposal*

Several changes have been made to the standards since proposal as the result of EPA's evaluation of comments and of additional information gathered in response to comments. These changes respond primarily to commenters' concerns that additional controls are unnecessary for TSDF process vents and equipment with very low emissions and that the applicability, implementation, and compliance provisions of the standards should be clarified. The EPA has addressed these problems in the final rules.

The proposed standards would have required that organic emissions from all process vents that emit organics in concentrations of 10 percent or greater on all TSDF waste management units be reduced by 95 percent. The final rules apply to process vents on specific hazardous waste management units that treat wastes with total organics concentrations of 10 ppmw or greater and include (1) process vents on distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations and vents on condensers serving these operations and (2) process vents on tanks associated with distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations if emissions from these process operations are vented through the tanks.

While the proposed standard would have required 95 percent emission reduction from each affected vent, the final vent standard's weight-percent reduction applies to total emissions from the combination of all affected vents at each facility. The final rules also add facility-based emission rate limits for all affected process vents of 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 ton/yr) (§§ 264.1032(a)(1) and 265.1032(a)(1)). Facilities with organic emissions from vents below the emission rate limits will not have to reduce process vent organic emissions. The owner or operator of the facility must determine and document that emissions from affected vents will not exceed the emission rate limits. The EPA estimates that baseline emissions will be reduced by about 90 percent by controlling process vent emissions from about 55 percent of affected facilities, i.e., those with emissions above the emission rate limit.

Another major change affects the applicability of the final standards for pumps and valves to better relate to the volatility of the wastes managed and thus to air emission LDAR potential. The proposed LDAR requirements for pumps and valves have been revised to distinguish between equipment in heavy liquid service and equipment in gas/light liquid service. The provisions exempt pumps and valves processing relatively low vapor pressure substances (heavy liquids) from the routine instrument monitoring requirements of the standards. These provisions are included to avoid requiring unnecessary controls on equipment that poses little emission problem even when leaking.

Because of commenters' concerns with the administrative problems associated with obtaining a major permit modification, the final standards do not require modifications of RCRA permits issued before the effective date of these rules (§§ 264.1030(c) and 264.1050(c)). In such cases, requirements for affected hazardous waste management units and associated requirements for process vents and equipment must be added or incorporated into the facility's permit at review under § 270.50 or at reissue under § 124.15. However, in the forthcoming Phase II air rules, EPA will be proposing to modify §§ 264.1030(c) and 264.1050(c) as they apply to control of air emissions under subparts AA and BB. This action, if adopted, would mean that the air rules promulgated under RCRA section 3004(n) would be applicable to all facilities as of the effective date of the Phase II rules. More details regarding implementation are presented in section IX of this preamble.

The proposed air emission standards for process vents and equipment leaks would have added part 269, Air Emission Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities. For consistency with standards for other TSDF sources under RCRA, the final standards have been incorporated into part 264, for permitted facilities, and part 265, for interim status facilities. In addition, whereas at proposal the equipment leak requirements of 40 CFR part 61, subpart V, were incorporated by reference, these provisions have been written into subpart BB with editorial revisions appropriate for a standard promulgated under RCRA authority rather than CAA authority.

### *E. Relationship of RCRA Exemptions to Final Standards*

Under 40 CFR 261.4(c), hazardous wastes that are generated in process-related equipment such as product or raw material storage tanks or pipelines are exempt from RCRA regulation. This exemption applies until the waste is physically removed from the unit in which it was generated, unless the unit is a surface impoundment or unless the hazardous waste remains in the unit more than 90 days after the unit ceases to be operated for manufacturing, or for storage or transportation of product or raw materials. This exemption is not affected by this rule. Therefore, units such as *product* (not hazardous waste) distillation columns generating hazardous waste still bottoms containing organics are not subject to the standard while the wastes are in the product distillation column. However, distillation columns that receive hazardous wastes and that are used in hazardous waste treatment (i.e., hazardous waste management units) are subject to this standard if the waste's organic content exceeds the 10-ppmw applicability criterion. As discussed in the preamble to the proposed standard, only those recycling units that are part of a facility already subject to RCRA permit requirements are subject to the air standards. The EPA's authority to control air emissions from solvent reclamation operations not part of closed-loop systems is discussed further in section VI of this preamble and in the BID.

Totally enclosed treatment facilities also are exempt from RCRA subtitle C requirements under 40 CFR 264.1(g)(5), 40 CFR 265.1(c)(9), and 270.1(c)(2). A "totally enclosed treatment facility" is a hazardous waste treatment facility that is "directly connected to an industrial production process and which is constructed and operated in a manner that prevents the release of any hazardous waste or any constituent thereof into the environment during treatment" (40 CFR 260.10).

Treatment facilities located off the site of generation are not directly connected to an industrial process. Thus, commercial waste treatment facilities with equipment affected by the final standards, such as solvent reclamation facilities, by definition ordinarily would not be totally enclosed. In addition, storage facilities, disposal facilities, and ancillary equipment not used for treating hazardous waste do not fall within the definition of a totally enclosed treatment facility.

The EPA believes that many on-site treatment facilities also are not totally enclosed. Distillation columns and other treatment technologies typically are designed to release emissions into the air. Therefore, by definition, these on-site technologies generally are not totally enclosed. (See 45 FR 33218, May 19, 1980 (no constituents released to air during treatment).)

Two important characteristics define a totally enclosed treatment facility. The key characteristic of a totally enclosed treatment facility is that it does not release any hazardous waste or constituent of hazardous waste into the environment during treatment. Thus, *if* a facility leaks, spills, or discharges waste or waste constituents, or emits waste or waste constituents into the air during treatment, it is not a totally enclosed treatment facility within the meaning of these regulations. The second important characteristic is that it must be directly connected to an industrial production process.

The EPA also excludes elementary neutralization and wastewater treatment tanks as defined by 40 CFR 260.10 from regulation under the hazardous waste rules. The EPA amended these definitions (see 53 FR 34080, September 2, 1988) to clarify that the scope of the exemptions applies to the tank systems, not just the tank. For example, if a wastewater treatment or elementary neutralization unit is not subject to RCRA subtitle C hazardous waste management standards, neither is ancillary equipment connected to the exempted unit. The amendments also clarify that, for a wastewater treatment unit to be covered by the exemption, it must be part of an onsite wastewater treatment facility. Thus, emissions from process vents associated with distillation, fractionation thin-film evaporation, solvent extraction, or air or steam stripping operations and ancillary equipment (piping, pumps, etc.) that are associated with a tank that is part of the wastewater treatment system subject to regulation either under sections 402 or 307(b) of the Clean Water Act are not subject to these standards. However, air emission sources not subject to RCRA may be subject to CAA guidance and/or standards.

As noted in the preamble to the proposal, under 40 CFR 262.34, generators that accumulate hazardous waste in tanks and containers for 90 days or less are not subject to RCRA permitting requirements, provided they comply with the provisions of 40 CFR 262.34, which include the substantive requirements for tanks and containers storing hazardous waste, 40 CFR part 265, subparts I and J. This remains unchanged, and the final standards do not apply to generator tanks that accumulate hazardous waste for 90 days or less. However, as part of the Phase II TSDF air emission regulations, EPA intends to propose to modify the exemption conditions to require that 90-day tanks meet the control requirements of the Phase I and Phase II standards.

Today's final rules regulate the activity of reclamation at certain types of RCRA facilities for the first time. The EPA is amending 40 CFR 261.6 under its RCRA authority over reclamation to allow covering reclamation of hazardous wastes in waste management units affected by today's final rules. It should be recognized, however, that these final rules apply only at facilities otherwise needing a RCRA permit. In addition, the closed-loop reclamation exemption in § 261.4(a)(8) is not changed by these rules. Therefore, not all reclamation units will necessarily be affected by these rules.

## VI. Summary of Comments and Responses

Numerous comments on the proposed rule were received that relate to nearly all aspects of the RCRA standards development process. The comment summaries cover topics relating to regulatory issues, applicability of the standards, control technologies impact analyses and implementation and compliance issues. Detailed responses to these and other comments are included in the BID for the promulgated standards, which is available in the public docket for this rule.

### *A. Regulatory Issues*

#### Statutory Authority

*Comment:* Several commenters argued that TSDF air emissions should be regulated under the CAA rather than RCRA because (1) CAA standards under sections 111 and 112 are already in place in the SOCMI and petroleum refining industries; (2) air emissions at some TSDF have already been permitted under State implementation plans (SIP), new source review programs, or under State regulations for VOC or air toxics control; (3) VOC and ozone control are the province of the CAA, not RCRA; and (4) a statutory mechanism already exists under the CAA for evaluating the risk posed by air emissions.

*Response:* Congress has required EPA to promulgate air emission monitoring and control requirements at hazardous waste TSDF, under section 3004(n) of RCRA, as may be necessary to protect human health and the environment. Congress was aware of the existence and scope of the CAA when it enacted section 3004(n) of RCRA. There is no indication that Congress intended that all air regulations be issued within the confines of the CAA. On the contrary, when adding section 3004(n), Congress specifically recognized EPA's dual authority to regulate these air pollutants (S. Rep. 98–284, page 63).

The EPA has conducted an analysis of current State and Federal controls and concluded that further regulation under section 3004(n) is necessary to protect human health and the environment. The EPA examined State regulations, as well as existing Federal standards (and those under development), to determine the potential for overlapping rules and permitting requirements. The EPA found that 6 States have established air toxics programs, 21 States have established generic standards for VOC independent of Federal regulations, and several States have extended control techniques guidelines (CTG) for VOC to TSDF. However, the standards vary widely in scope and application and in many cases controls have not been required when emissions are below 40 ton/yr, even in the 37 States with ozone nonattainment areas. The EPA believes that today's action will help alleviate the nonuniformity among the States' efforts and will help achieve emission reductions necessary to protect human health and the environment.

A few commenters also argued that the standards would duplicate existing CAA standards that apply to the SOCMI and petroleum refineries. The EPA disagrees because the standards being promulgated today apply to waste management sources whereas the CAA standards previously promulgated apply to the production process.

The EPA also disagrees with contentions that it is outside the province of RCRA to address VOC and ozone. As noted, section 3004(n) standards, like all RCRA subtitle C standards, are to protect "human health and the environment." VOC and ozone are threats to human health and the environment and thus are well within the regulatory scope of section 3004(n).

Organic emissions from TSDF contribute to ambient ozone formation. In fact, TSDF are estimated to emit nearly 12 percent of all VOC from stationary sources, and thus any reductions in these emissions will contribute to reducing ozone formation and associated health and environmental problems.

#### RCRA Authority Over Recycling

*Comment:* Several commenters argued that EPA does not have regulatory authority under RCRA to control solvent reclamation operations or units or equipment managing materials destined for reclamation such as spent solvent because they are producing or managing products and not wastes.

*Response:* The EPA disagrees with the commenters regarding EPA's authority to control solvent reclamation operations. In response to a court opinion (*American Mining Congress* v. *EPA*, 824 F.2d 1177, DC Circuit Court of Appeals, July 31, 1987) concerning the scope of EPA's RCRA authority, EPA proposed amendments to the RCRA definition of "solid waste" that would clarify when reclamation operations can be considered to be managing solid and hazardous wastes (53 FR 519, January 8, 1988). The EPA has accepted comments on its interpretation and proposed amendments. The EPA has not yet taken final action on this proposal. Thus, EPA is addressing the scope of its authority over reclamation operations under RCRA in the context of that rulemaking. This rule is based on EPA's current interpretation of its RCRA authority, as described in the January 1988 proposal.

The following summarizes EPA's proposed position. In general, the proposed amendments would exclude from RCRA control only those spent solvents reclaimed as part of a continuous, ongoing manufacturing process where the material to be reclaimed is piped (or moved by a comparably closed means of conveyance) to a reclamation device, any storage preceding reclamation is in a tank, and the material is returned after being reclaimed, to the original process where it was generated. (Other conditions on this exclusion relate to duration and purpose of the reclamation process. See proposed § 261.4(a)(8).)

However, processes (or other types of recycling) involving an element of "discard" are (or can be) within RCRA subtitle C authority. When spent materials are being reclaimed, this element of discard can arise in two principal ways. First, when spent materials are reclaimed by someone other than the generator, normally in an off-site operation, the generator of the spent material is getting rid of the material and so is discarding it. In addition, the spent material itself, by definition, is used up and unfit for further direct use; the spent material must first be restored to a usable condition. This type of operation has been characterized by some of the worst environmental damage incidents involving recycling (50 FR 658–661, January 4, 1985). Moreover, storage preceding such reclamation has been subject to the part 264 and 265 standards since November 19, 1980. (See generally 53 FR 522 and underlying record materials.) The *American Mining Congress* opinion itself indicates that such materials are solid wastes (824 F.2d at 1187).

When a spent material is reclaimed on site in something other than a closed-loop process, EPA also considers that the spent material is discarded (*i.e.*, spent solvents removed from the process, transferred to an on-site distillation unit, and regenerated have been removed from the production process). The EPA's reasoning is that these materials are no longer available for use in an ongoing process and have been disposed of from that operation, even if the reclamation operation is on site. Finally, EPA also considers that when hazardous secondary materials are reclaimed but then burned as fuels, the entire operation—culminating in thermal combustion—constitutes discarding via destructive combustion (53 FR 523). Consequently, under this reading, any intermediate reclamation step in these types of fuel production operations remains within EPA's subtitle C authority.

In summary, under EPA's current interpretation of the court's opinion, air emissions from distillation, fractionation, thin-film evaporation, solvent extraction, and stripping processes involving reclamation of spent solvent and other spent hazardous secondary materials can be regulated under RCRA subtitle C whenever the reclamation system is not part of the type of closed-loop reclamation system described in proposed part 261.4(a)(8). Any changes to this interpretation as part of the solid waste definition final rule may affect the scope of this rule.

### Selection of Source Category

*Comment:* Several commenters disagreed with the selection of TSDF and Waste Solvent Treatment Facility (WSTF) process vents and equipment leaks for regulation because they believed that (1) out-of-date data or extrapolated data were used in the analysis and, as a result, the estimate of the number of affected facilities nationwide and the number affected by the proposed rule is far too low; (2) the role of State regulations was not considered; (3) EPA should control larger, more hazardous air emission sources at TSDF, such as storage tanks, before controlling process vents and equipment leaks; and (4) air emissions from waste solvent reclamation operations do not pose a health risk warranting control.

*Response:* The EPA generally disagrees with the commenters that the selection of TSDF process vents and equipment leaks was inappropriate. However, EPA agrees that the standards will affect more than the 100 WSTF estimated at proposal. To respond to these and other comments, EPA conducted additional technical analyses. The EPA developed an industry profile using results of the 1986 National Screening Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities (hereafter called the "Screener Survey"). The Screener Survey data represent all of the TSDF active in 1985 with interim status or final RCRA permits, which totalled about 3,000 facilities. The Screener Survey data are for operations in 1985, the latest year for which such comprehensive data are available. A review of the Screener Survey data shows a total of about 450 facilities that need authorization to operate under RCRA section 3005 and report solvent recovery by operations such as batch distillation, fractionation, thin-film evaporation, or steam stripping at the facility; i.e., operations that would have process vents subject to the standards. The EPA used these facility counts together with the reported 1985 waste solvent throughputs as the basis for the final process vent standards impacts analyses. In addition, EPA estimates that about 1,000 on site and off site permitted TSDF that do not practice solvent recovery do manage hazardous waste streams containing 10 percent or more total organics and would be subject to the equipment leak requirements. In total, about 1,400 facilities are potentially subject to the provisions of subpart BB.

State and Federal regulations also were reviewed to help EPA better estimate baseline emission control levels. Although a few States have controls in place, it appears that there are no general control requirements for TSDF process vents. Moreover, because TSDF with solvent recycling generally are small operations, any new waste management units with process vents would likely have potential VOC emissions of less than 40 ton/yr; thus, prevention of significant deterioration (PSD) permit requirements would not apply. In addition, EPA sent section 3007 information requests to several large and small TSDF; respondents to the EPA section 3007 questionnaires did not indicate control requirements for process vents. Several of the facilities that were asked to provide information reported requirements for obtaining air contaminant source operating permits, but they reported no permit requirements for controlling process vent emissions. Therefore, the revised emission estimates (that are based on site-specific emission data) should reasonably reflect the current level of control of process vent emissions.

With respect to those commenters who argued that other air emission sources should be controlled instead of process vents and equipment leaks, it should be pointed out that section 3004(n) of RCRA requires EPA to promulgate regulations for the monitoring and control of air emissions from hazardous waste TSDF, *including but not limited to* open tanks, surface impoundments, and landfills, as may be necessary to protect human health and the environment. Organic emissions are generated from process vents on distillation and separation units such as air strippers, steam strippers, thin-film evaporators, fractionation columns, batch distillation units, pot stills, and condensers and distillate receiving vessels that vent emissions from these units. Distillation and separation processes may be found in solvent reclamation operations, wastewater treatment systems, and in other pretreatment processes. Organic emissions also are released from equipment leaks associated with these processes as well as from nearly all other hazardous waste management units.

As discussed in section III.D of this preamble, the EPA chose to develop the process vent and equipment leak portion of its TSDF rulemaking as the first phase of the TSDF air emission rules partly to prevent uncontrolled air emissions from LDR treatment technologies since these technologies were likely to have increased use. In addition, EPA already had control technology information to support these regulations, and thus earlier development of these rules was possible. This is principally because effective controls now in place under the CAA to control emissions from the same types of emission points in chemical production facilities and petroleum refineries can be applied to reduce the health risk posed by air emissions from uncontrolled distillation, fractionation, thin-film evaporation, solvent extraction, and stripping processes and equipment leaks at TSDF. The EPA has limited the applicability of today's final standards to those types of process vents for which control techniques are well developed, i.e., those associated with processes designed to drive the organics from the waste, such as distillation, fractionation, thin-film evaporation, solvent extraction, and stripping operations.

Organic emissions also are generated from numerous other sources at TSDF. Preliminary estimates indicate that nationwide organic emissions (after control of process vents associated with distillation/separation units and equipment leaks) are about 1.8 million Mg/yr. The EPA is in the process of developing standards for these sources under section 3004(n) of RCRA, and the standards are scheduled for proposal in 1990. Source categories being examined include tanks, surface impoundments, containers, and miscellaneous units. These other TSDF source categories require different data and engineering evaluations; thus, standards for these other sources are on a separate rulemaking schedule. The emissions and risk analyses needed to support extension of the process vent standards to other closed (covered), vented tanks are also being developed in conjunction with this future rulemaking. These include vent emissions that are incidental to the process, such as emissions caused by loading or by agitation/ aeration of the waste in a treatment tank.

The EPA has determined that organic emissions from TSDF/WSTF process vents and equipment leaks pose a significant risk to human health and the environment and that section 3004(n) provides authority to control TSDF air emissions from these sources. Therefore, EPA has decided to take measures to reduce the atmospheric release of organic air pollutants from these sources as quickly as possible. The fact that distillation, fractionation, thin-film evaporation, solvent extraction, and stripping processes and equipment leaks are regulated before other sources is not germane. There is no reason to delay these rules while others are under development.

Other commenters criticized the selection of the source category for regulation because their process vent emissions either are already controlled or are low enough so as not to pose a threat to human health and the environment. However, EPA's analysis of process vent emissions and impacts indicates that for a large segment of the industry, TSDF process vent emissions can pose significant environmental and health risks. These facilities are the target of the subpart AA process vent standards. As discussed in section VI.B of this preamble, the final standards include facility process vent emission rate limits designed to avoid control of facilities where meaningful reductions in nationwide risk to human health and the environment cannot be achieved.

Several commenters also criticized the source category for regulation because emissions from generators who conduct on-site reclamation and off-site reclaimers with no prior storage (i.e., those recycling activities conducted at facilities not requiring a RCRA permit) would not be controlled.

The standards being promulgated today (under section 3004[n]) apply only to waste management facilities that need authorization to operate under section 3005 of RCRA. Air emissions from subtitle C waste management facilities that are excluded from RCRA permit requirements will be subject to regulation under either the CAA or RCRA authority as appropriate. Waste management facilities that fall under the requirements of subtitle D (i.e., nonhazardous waste operations) will also be subject to regulation under the CAA. The EPA limited the scope of the standards at proposal and in this final rule to facilities required to have a permit under RCRA to minimize disruption to the current permitting system (i.e., not expand the permit universe) and not impose a permit burden on facilities not otherwise subject to RCRA permits. Although EPA is controlling only some sources in this rule, other sources of significant levels of air emissions will also be controlled; i.e., it is a matter of timing rather than a decision not to control these other sources. This phased regulatory approach is discussed in section III.C of this preamble.

### RCRA Decision Criteria

*Comment:* Several commenters alleged that the standards do not meet the mandate of RCRA section 3004(n) because (1) the standards are not protective in all cases; (2) the standards are inconsistent with RCRA section 3004(m) that requires treatment standards based on best demonstrated available technology (BDAT); and (3) neither the RCRA statute nor its legislative history allows consideration of costs.

*Response:* The EPA believes that the standards promulgated today appreciably reduce health risks that are presented by air emissions at TSDF and provide protection to human health and the environment as required by section 3004(n) of RCRA, for the vast majority of the air emissions affected by these standards. The EPA's analysis of residual cancer risk after implementation of the standards for process vents indicates that maximum individual risk, even at the upper-bound emission rate, is well within the residual risk for other standards promulgated under RCRA, which historically has been in the range of $1 \times 10^{-4}$ to $1 \times 10^{-6}$. On the other hand, the analysis indicates that residual cancer risk after implementing the equipment leak standards is higher than the residual risk for other standards promulgated under RCRA. However, EPA believes that the equipment leak standards achieve significant reductions in emissions and risk and, that after control, the vast majority of facilities are well within the risk range of other RCRA standards.

As was already described, EPA will be promulgating regulations to control TSDF air emissions in phases. Thus, in Phase III, EPA will be evaluating the need for additional control (e.g., control of individual toxic constituents after implementation of these standards) for cases where the risk from air emissions after implementation of the Phase I and II standards is higher than desirable. (This regulatory approach is discussed in section III.C of this preamble.) During the interim, permit writers should use EPA's omnibus permitting authority to require more stringent controls at facilities where a high residual risk remains after implementation of the standards for volatile organics. The permitting authority cited by section 3005 of RCRA and codified in § 270.32(b)(2) states that permits "* * * shall contain such terms and conditions as the Administrator or State Director determines necessary to protect human health and the environment." This section allows permit writers to require emission controls that are more stringent than those specified by a standard.

As has been described above, the approach that EPA is using to control TSDF air emissions is to proceed with promulgation of regulations to control organic emissions as a class (Phases I and II) and to follow this with regulations that would require more stringent controls for cases where the risk after implementing the organic standards remains high. The EPA believes that this approach will ultimately be protective of human health and the environment for all TSDF air emissions on a nationwide basis.

The question of whether these standards implement the requirements of RCRA section 3004(m) is irrelevant. Regulations implementing section 3004(m), which is a pretreatment-based program that defines when hazardous wastes can be land-disposed, have been (and will continue to be) separately promulgated by EPA. For example, see 40 FR 286 (November 7, 1986) and 52 FR 25787 (July 8, 1987). In contrast, today's regulations under section 3004(n) of RCRA do not specify technology-based treatment levels for hazardous wastes but regulate air emissions from treatment units as necessary to protect human health and the environment. Therefore, in developing today's rule EPA has focused on achieving acceptable levels of health and environmental protection rather than on specifying pretreatment levels for hazardous wastes. The two regulatory efforts (i.e., 3004(m) and 3004(n) rules) are integrated and coordinated to the extent possible to reduce duplicate and conflicting regulations. Furthermore, today's rules are designed to ensure that treatment required under 3004(m) is protective of human health and the environment.

The role of costs as a decision criterion under RCRA in subtitle C is not explicitly addressed in the statute. The EPA's position is that it can consider cost information as a basis for choosing among alternatives either (1) when they all achieve protection of human health and the environment or (2) for alternatives that are estimated to provide substantial reductions in human health and environmental risks but do not achieve the historically acceptable levels of protection under RCRA, when they are equally protective. However, EPA does not believe that the cost burden on industry is a basis for reducing the stringency of standards EPA considers necessary to protect human health and the environment.

### Total Organics Approach

*Comment:* Commenters argued that applicability should be limited to known or suspected carcinogens. In addition, several commenters argued that applicability of the standards should be based on volatility and not on total organic content because the relative amount of organic content by weight does not determine potential air emissions and subsequent health effects.

*Response:* First, it should be pointed out that ozone presents a threat to human health and the environment that warrants control under RCRA. The EPA agrees that total organic content may not be a completely accurate gauge of potential environmental (e.g., ozone) or health (e.g., cancer) impacts for a source such as process vents, but it is a readily measurable indicator. In addition, the final rule's substantive control requirements do apply only to vents and equipment containing volatile components.

The final vent standard applies to certain process vents emitting organics if the vent is associated with one of the processes specified in the rule. A process vent is determined to be affected by the standard if the vent is part of a hazardous waste distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping unit that manages wastes with 10 ppmw or more total organics; this includes vents on tanks (e.g., distillate receivers or hot wells) if emissions from the process operations are vented through the tank. Total organic content of the vent stream (i.e., the emissions to the atmosphere) is not a consideration in determining process vent applicability. As public commenters pointed out, the 10-percent total organics concentration cutoff for the vent stream does not limit total emissions or relate to emissions that escape capture by existing control devices and therefore was not included in the final rules.

Furthermore, the process vents covered by this rule are typically associated with distillation/separation processes used to recycle spent solvents and other organic chemicals. By definition, distillation is a process that consists of driving gas or vapor from liquids or solids by heating and then condensing the vapor(s) to liquid products. Wastes treated by distillation are expected to contain organics that are driven off in the process. Thus, by their nature, process vent emissions contain volatile organics.

Under the final standards, the term "organic emissions" is used in lieu of "volatile organic emissions" to avoid confusion with "volatile organic compounds." As at proposal, the final rule applies to total organics. Because of the hundreds of hazardous constituents that could be contained in and contacted by the equipment covered by today's rules, EPA recognizes the potential for the residual risk at some facilities to remain higher than the residual risk for other standards promulgated under RCRA. Regulations based only on specific constituents will therefore be developed, as necessary, in Phase III of EPA's regulatory approach. The constituents to be evaluated will include those reported as being present in hazardous wastes managed by existing TSDF for which health effects have been established through the development of unit risk factors for carcinogens and reference doses for noncarcinogens.

As is discussed in section VI.B of this preamble, emission potential from equipment leaks also was considered by incorporating the light-liquid definition in the section 111 CAA standards. Light liquids exhibit much higher volatilities than do heavy liquids, which are relatively nonvolatile. Equipment leak rates and emissions have been shown to vary with stream volatility; emissions from heavy liquids are far less than those for lighter, more volatile streams. For example, EPA analyses indicate that emissions from valves in heavy-liquid service are more than 30 times lower than the emissions from valves in light-liquid service (see the BID, § 4.6). The EPA examined the emissions and risk associated with light- and heavy-liquid waste streams and found that light-liquid streams are the overwhelming contributors to both emissions and risk. Thus, the final standards take into account the volatility of emissions and the subsequent impact on health and the environment.

### Application of CAA Equipment Leak Standards

*Comment:* Several commenters did not agree that the standards should be based on the transfer of technology from the section 112 standards for benzene (40 CFR, subpart V) because TSDF waste streams and processes differ from the chemical plants and petroleum refineries upon which the CAA standards are based.

*Response:* Data used in establishing the benzene fugitive standards under CAA section 112 are based on extensive emission and process data collected at a variety of petroleum refinery and SOCMI operating units. Data were obtained for equipment and chemical component mixtures that include many of the same organic compounds that are treated, stored, and disposed of in hazardous waste management units. Because hazardous waste management units such as distillation units have the same sources of fugitive organic emissions (such as pumps and valves) and handle the same chemicals as do chemical manufacturing plants and petroleum refineries, it is reasonable to expect similar performance and efficiency of the technology for controlling organic emissions at hazardous waste management units. The EPA has no reason to believe that the equipment standards would not be applicable to TSDF. Moreover, although EPA has not conducted actual equipment leak testing at TSDF, observations of equipment during plant visits have confirmed that the assumptions and analyses used in other equipment leak standards apply to TSDF as well.

Changes have been made in the final standards and analyses to incorporate provisions included in the CAA standards that reflect the effect of volatility on emissions. As is discussed in section V of this preamble, the LDAR requirements for pumps and valves have been revised to include the light-liquid provisions in EPA's NSPS for VOC equipment leaks in the SOCMI. Correspondingly, the emission and health risk analyses have been revised to reflect this change to the standards. Additional information on the appropriateness of the CAA data on the SOCMI and petroleum refineries is presented in the next section.

## *B. Standards and Applicability*

### Standards for Accumulator Vessels

*Comment:* Commenters contended that the regulatory approach of applying a single standard to the wide varieties of accumulator vessels irrespective of the chemical constituents that are present and the size of the vessel is not appropriate because the proposed standards result in the control of already low emission rates at disproportionately high costs. Standards for tanks (whether accumulation or storage tanks) should be conditioned by the size of the vessel, the vapor pressure of the material being stored, and the type of units that pose a risk to human health and the environment. The EPA's approach should be similar to or consistent with the CAA NSPS for petroleum liquid storage vessels (40 CFR part 60, subpart Ka). These standards exempt vessels that store liquids less than 1.5 psia or that store less than 40,000 gal.

*Response:* Commenters recommending that the air emission standards be conditioned by the size of the tank and the vapor pressure of the material being stored have misinterpreted the applicability of the proposed standards. To clarify the applicability of the standards, the term "product accumulator vessel" has been dropped from the promulgated rule, including the equipment definition, and the process vent definition has been revised to be specific to the applicable emission sources. "Process vent" is defined to mean "any open-ended pipe or stack that is vented to the atmosphere either directly, through a vacuum-producing system, or through a tank (e.g., distillate receiver, condenser, bottoms receiver, surge control tank, separator tank, or hot well) associated with distillation fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations." Similarly, the definition of "vented" has been revised to specifically exclude the passage of liquids, gases, or fumes "caused by tank loading and unloading (working losses)." Because tank working and breathing losses are not considered process emissions, the comments concerning vapor pressure and tank size exemptions are not relevant. (It should be noted, however, that EPA intends to regulate hazardous waste storage tanks, along with various other TSDF air emission sources in the Phase II, section 3004(n), TSDF air standards now being developed and evaluated by the Agency.)

In conducting the impact analysis of the WSTF/TSDF process vent standards, EPA considered and took into account the relative size of WSTF process units and the wide range of chemicals processed in the WSTF industry. For example, three sizes of WSTF model units were defined for analysis of emissions, health risks, and economic impacts in the final rulemaking (see section VI.D). In addition, the final standards for process vents promulgated by EPA contain emission rate limits and require controls only at facilities whose total process vent emissions are greater than 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 ton/yr). More detailed descriptions of the model units and the process vent emission rate limits are provided in chapters 5.0 and 7.0, respectively, of the BID.

*Comment:* Several commenters objected to the proposed standard for process vents that requires a fixed 95-percent emission reduction. They believe that the process vent standard is inequitable because some operations could reduce emissions by 95 percent and still have higher emissions than some small uncontrolled operations and because facilities would have to install control devices on all condenser and still vents regardless of emissions or risk posed to human health or the environment. A few commenters asked EPA to consider exemptions for small solvent operations that have low emissions and thus pose little health risk.

*Response:* In response to these comments, EPA estimated the TSDF/WSTF air quality and health impacts using updated model unit, emission rate, and facility throughput data. Although total facility waste solvent throughputs were available, the data base did not contain any information on the number or capacities of process units at each site. Therefore, the risk analysis is based on overall facility operations and total facility process vent emissions as opposed to individual process vent emissions. The impacts analysis results show that nationwide reductions in emissions, maximum individual risk (MIR), and cancer incidence level off (i.e., yield only insubstantial incremental reductions) at a facility emission rate of about 2.8 Mg/yr (3.1 ton/yr). At a typical rate of 2,080 h/yr of operation, this annual emission rate corresponds to 1.4 kg/h (3 lb/h) of organic emissions. Control of facilities with process vent emissions less than these values does not result in further reductions of nationwide MIR or cancer incidence. At this emission level, larger facilities (i.e., those with uncontrolled emissions above the emission rate limit) that are controlled to a 95-percent emission reduction result in MIR values higher than the remaining uncontrolled small facilities (i.e., those with uncontrolled emissions below the limit). The same holds true for nationwide cancer incidence. The reduction in cancer incidence achieved by controlling facilities below the limit is not significant relative to the nationwide reductions achieved by controlling the larger facilities.

Consequently, the analysis results indicate that provision of small facility emission rate limits of 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 ton/yr) for process vent emissions provides essentially the same level of protection for human health and the environment (in terms of risk, incidence, and emissions) as does covering all facilities. In addition, the MIR after control is within the range of residual risk for other standards promulgated under RCRA. As a result, the final rule requires control of only those facilities emitting greater than 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 ton/yr) organic emissions from all process vents. A more detailed discussion of the process vent emission rate limits is contained in chapter 7.0 of the BID.

Because the final standards contain process vent emission rate limits, it is anticipated that small solvent recovery operations would not be substantially affected by the final process vent standards. The EPA estimates, based on the high emission rates and 1985 waste solvent throughput data, indicate that about 45 percent of the WSTF identified in the industry profile will have process vent emissions of less than 2.8 Mg/yr (3.1 ton/yr). Consequently, it is expected that a large number of small facilities would not be required to install additional process vent controls.

Selection of 10-Percent Cutoff

*Comment:* Commenters believed that the 10-percent level proposed is comparable to 100,000 ppm and may be too high, particularly when compared to the 10,000-ppm level that defines an equipment leak, and that EPA should evaluate the health and environmental impacts associated with the proposed limit. The 10-percent limit will allow excessive emissions from leaking equipment and is based on costs, not technical limitations. Commenters also argued that the 10-percent limit does not adequately protect the environment because emissions could be substantial if there are numerous leaking components with relatively dilute streams and that controls, such as carbon adsorbers, are available to capture emissions from dilute streams.

*Response:* First, for clarification, the 10-percent organic content limit for equipment leaks in no way relates to the 10,000-ppm leak definition. The leak definition, which is a Method 21 instrument reading used to define when a leak is detected, is discussed in a later comment. As proposed, the 10-percent total organics cutoff level for applicability of the standards covered both equipment leak (fugitive) emissions and process vent emissions. Control technologies for fugitive emissions comprise the use of control equipment, inspection of equipment, and repair programs to limit or reduce emissions from leaking equipment. These control technologies have been studied and evaluated for equipment containing fluids with more than 10 percent organics (EPA–450/3–80–32b, EPA–450/3–80–33b, EPA–450/3–82–010, and EPA–450/3–86–002). The 10-percent criterion was chosen in EPA's original benzene/SOCMI studies to focus the analyses on air emissions from equipment containing relatively concentrated organics and presumably having the greatest potential for air emissions. Available data from the original benzene/SOCMI studies do not suggest that fugitive emissions from leaking equipment (e.g., pumps and valves) handling streams containing less than 10 percent organics are significant or that the 10-percent cutoff allows excessive emissions from dilute streams.

However, to reevaluate this would require several years to conduct field studies to collect and analyze additional emissions and control effectiveness data for equipment leaks. Because available data support the need for, and effectiveness of, standards for equipment handling streams containing at least 10 percent organics, the EPA does not believe that a delay in rulemaking to assess emissions and controls for equipment handling streams containing less than 10 percent organics is warranted.

The effectiveness of fugitive emission control technologies has been thoroughly evaluated for equipment containing fluids with at least 10 percent organics, and fugitive emission standards have been proposed or established under both sections 111 and 112 of the CAA. (See 46 FR 1136, January 5, 1981; 46 FR 1165, January 5, 1981; 48 FR 279, January 4, 1983; 48 FR 37598, August 18, 1983; 48 FR 48328, October 18, 1983; 49 FR 22598, May 30, 1984; 49 FR 23498, June 6, 1984; and 49 FR 23522, June 6, 1984.) As elaborated in these rulemakings, a 10-percent cutoff deals with the air emissions from equipment most likely to cause significant human health and environmental harm.

With regard to process vent emissions, EPA agrees with the commenter. Emission test data show that the 10-percent cutoff potentially may allow significant emissions from process vents on a mass-per-unit-time basis (e.g., kg per hour or Mg per yr). As public commenters pointed out, the 10-percent cutoff for process vents does not limit total emissions, nor does it relate to emissions that escape capture by existing control devices. Therefore the 10-percent cutoff may not be appropriate; as a result, EPA has eliminated the 10-percent cutoff as it applies to process vents. The EPA believes that an emission rate limit more effectively relates to emissions, emission potential, and health risks than does a 10-percent organic concentration cutoff. Accordingly, a health-risk-based facility process vent emission rate limit has been added to the final rules in lieu of the 10-percent cutoff.

Because the emission rate limits (3 lb/h and 3.1 ton/yr) provide health-based limits, EPA considered dropping completely the organic content criterion (i.e., at least 10 percent total organics). However, EPA decided not to eliminate completely the organic content criterion because it is not clear that the same controls can be applied to very low concentration streams as can be applied to the higher concentration streams that generally are associated with emission rates greater than the limits. For low-concentration streams, EPA questions whether controls are needed on a national or generic basis, but is unable to resolve this question at this time. Thus, EPA decided to defer controlling very low concentration streams until it is able to better characterize and assess these streams and the appropriate controls.

Once EPA decided to consider facilities that manage very low concentration organic wastes as a separate category, there remained the problem of determining the appropriate criterion. The EPA examined existing data on air strippers, the treatment device most commonly used with low-concentration streams; it appeared that the quantity of emissions and the risk associated with air strippers treating streams with concentrations below 10 ppmw may be relatively small, thus minimizing the potential harm of deferring control until a later time. Examples of facilities managing low-concentration wastes are sites where ground water is undergoing remedial action under CERCLA or corrective action pursuant to RCRA. Based on the limited set of precise data available, and the comments that the 10-percent criterion was too high, EPA determined that an appropriate criterion would be 10 ppm total organics in the waste by weight.

The 10-ppmw criterion is not an exemption from regulation; it is intended only as a way for EPA to divide the air regulations into phases. The EPA is deferring action on very low concentration streams (i.e., ones with less than 10 ppmw total organic content) from the final rule today but will evaluate and announce a decision later on whether to regulate these waste streams.

### Exemptions

*Comment:* Several commenters disagreed with EPA's interpretation that the definition of "totally enclosed treatment units" (which are exempt from regulation) may in certain circumstances include on-site treatment units that use engineered controls to prevent the release of emissions. One commenter stated that on-site treatment facilities directly tied with process equipment have the same potential for emissions as do other sources not exempted by the proposed regulation.

*Response:* This rule does not create or modify any exemption for totally enclosed treatment facilities; rather, the existing definition of an exemption for totally enclosed treatment facilities remains in effect, and existing regulatory interpretations remain in effect as well. Although the preamble to the proposed rule repeated the existing definition, it also contained a request for comments on an interpretation of the totally enclosed facility exemption whereby the "use of effective controls such as those required by the proposed standards" would meet the criteria of 40 CFR 260.10. Upon consideration of the comments, EPA has determined that this interpretation would have conflicted with the regulatory definition and previous interpretations of the exemption and, therefore, has decided to withdraw it.

As presented in the preamble to the proposed rule, under 40 CFR 264.1(g)(5) and 40 CFR 265.1(c)(9), totally enclosed treatment facilities are exempt from RCRA regulation. A "totally enclosed treatment facility" is a facility treating hazardous waste that is "directly connected to an industrial production process and which is constructed and operated in a manner which prevents the release of any hazardous waste or constituent thereof into the environment during treatment" (40 CFR 260.10). Therefore, as stated in the proposal preamble, process equipment designed to release air emissions are not "totally enclosed."

The EPA agrees with the commenter that on-site treatment facilities associated with process equipment generally are designed to release air emissions and, thus, are not "totally enclosed." The EPA specifically stated this in the preamble to the proposed rule. To be considered "totally enclosed," units must meet the test of preventing the release of any hazardous constituent from the unit not only on a routine basis but also during a process upset. Thus, the risks from these units are expected to be less than from units that are not totally enclosed.

*Comment:* Commenters stated that the exemption for tanks storing or treating hazardous wastes that are emptied every 90 days and that meet the tank standards of 40 CFR 262.34 is not justified based on risk, as RCRA requires. The exclusion of less-than-90-day storage tanks from air emission control requirements will increase the use of the 90-day storage exemption and the resultant air emissions.

*Response:* In 40 CFR part 270, hazardous waste generators who accumulate waste on site in containers or tanks for less than the time periods provided in § 262.34 are specifically excluded from RCRA permitting requirements. To qualify for the exclusion in § 262.34, generators who accumulate hazardous waste on site for up to 90 days must comply with 40 CFR

265, subpart I or J (depending on whether the waste is accumulated in containers or tanks) and with other requirements specified in § 262.34. Small-quantity generators (i.e., generators who generate more than 100 kilograms but less than 1,000 kilograms per calendar month) are allowed to accumulate waste on site for up to 180 days or, if they must ship wasteoff site for a distance of 200 miles or more, and if they meet certain other requirements set out in § 262.34, for up to 270 days.

The promulgated regulation does not create a new exemption for 90-day accumulation, nor does it modify the existing regulation. As the commenter notes, EPA is considering what changes (if any) should be made to § 262.34 (the "90-day rule") under a separate rulemaking (51 FR 25487, July 14, 1986). As part of that effort, EPA currently is evaluating whether air emissions from these and other accumulator tanks, mentioned above, at the generator site should be subject to additional control requirements. Preliminary analysis indicates that 90-day tanks and containers may have significant organic air emissions; consequently, as part of the second phase of TSDF air emission regulations, EPA is considering proposing to modify the exemption to require that 90-day tanks meet the control requirements of the Phase I and II standards. (The multiphased standards development approach for regulating organic air emissions is discussed in section III.C of this preamble.) Until a final decision is made on regulating the emissions from these units, they will not be subject to additional controls. However, EPA does not believe that more generators will use the 90-day exemption if air emission controls are not imposed on these units. Those generators who are eligible for inclusion under § 262.34 are probably already taking advantage of the provision now by storing their hazardous wastes for less than 90 days.

### LDAR Program

*Comment:* Several commenters criticized the incorporation of the national emission standard for hazardous air pollutants (NESHAP) for benzene because of differences in scope from the SOCMI NSPS in that (1) the NSPS distinguishes between light and heavy liquids and the proposed standards based on the benzene NESHAP do not; (2) the NSPS does not require testing of all SOCMI units because process fluid vapor pressure is the overriding consideration in predicting leak frequencies and leak rates (the proposed standards incorporating the NESHAP do not recognize vapor pressure and require testing of all SOCMI units); and (3) the NSPS exempts facilities from routine fugitive emission monitoring, inspection, and repair provisions if a heavy-liquid product from a heavy-liquid raw material is produced and limits monitoring of equipment in heavy-liquid service only to where there is evidence of a potential leak.

*Response:* The EPA agrees with the commenters that the provisions for light and heavy liquids in the SOCMI NSPS should be incorporated in the section 3004(n) standards, even though the subpart V NESHAP does not contain the distinction. No distinction was made for the benzene NESHAP because benzene is a light liquid. By their nature, heavy liquids exhibit much lower volatilities than do light liquids and because equipment leak emissions have been shown to vary with stream volatility, emissions for heavy liquids are less than those for lighter and more volatile ones. As previously noted, EPA analyses have determined that the emission rate for a valve in heavy-liquid service is more than 30 times less than the emission rate for a valve in light-liquid service. In response to these comments, EPA examined the emission and risk associated with light- and heavy-liquid waste streams and found that light-liquid streams are the overwhelming contributors to both emissions and risk. Therefore, a routine LDAR monthly inspection is not necessary for heavy liquids.

Thus, the final regulations have been changed to incorporate the light/heavy-liquid service provisions for pumps and valves (40 CFR parts 264 and 265, subpart BB, §§ 264.1052, 264.1057 265.1052, and 265.1057). Equipment is in light-liquid service if the vapor pressure of one or more of the components is greater than 0.3 kPa at 20 °C, if the total concentration of the pure components having a vapor pressure greater than 0.3 kPa at 20 °C is equal to or greater than 20 percent by weight, and if the fluid is a liquid at operating conditions. The 0.3-kPa vapor pressure criterion is based on fugitive emission data gathered in various EPA and industry studies (EPA-450/3-82-010). Equipment processing organic liquids with vapor pressures above 0.3 kPa leaked at significantly higher rates and frequencies than did equipment processing streams with vapor pressures below 0.3 kPa. Therefore, EPA elected to exempt equipment processing lower vapor pressure substances (i.e., heavy liquids) from the routine LDAR requirements of the standards. In addition, monitoring of equipment in heavy-liquid service is required only where there is evidence by visual audible olfactory, or any other detection method of a potential leak.

*Comment:* Several commenters asked EPA to consider exemptions from fugitive emission monitoring for small facilities based on volume (as was done in the benzene NESHAP and the SOCMI NSPS), emission threshold, product applicability threshold or equipment component count, or equipment size. In support, the commenters pointed to similar exemptions in the CAA rules that were in the proposed standards.

*Response:* The commenters suggest that EPA consider other exemptions for fugitive emission monitoring that are applied in the benzene NESHAP or SOCMI NSPS (e.g., small facilities with the design capacity to produce less than 1,000 Mg/yr). The EPA recognizes that estimated emissions and health risks from small facilities should be considered in the final rules. With regard to the SOCMI NSPS small-facility exemption, the cutoff was based on a cost-effectiveness analysis. Under section 111 of the CAA, EPA may exempt units where costs of the standards are unreasonably high in comparison to the emission reduction achievable. Under RCRA, the statutory criterion is protection of human health and the environment. Therefore, any cutoff for RCRA standards must be risk-based. Cost effectiveness is only a relevant factor for choosing among alternatives either (1) when they all achieve protection of human health and the environment or (2) for alternatives that are estimated to provide substantial reductions in human health and environmental risks but do not achieve the historically acceptable levels of protection under RCRA, when they are equally protective.

In the benzene NESHAP (49 FR 23498, June 6, 1984), EPA concluded that control of units producing less than 1,000 Mg/yr did not warrant control based on the small health-risk potential. The benzene standards, however, did not have to deal with the many different pollutants covered by the TSDF process vent and equipment leak standards, some of which are much more carcinogenic than benzene. In addition to unit size (or throughput), fugitive emissions are also a function of the chemical characteristics of the hazardous wastes being handled.

Typically, TSDF have a variety of hazardous waste management processes (e.g., container storage, tank storage, treatment tanks, incinerators, injection wells, and terminal loading operations) located at the same facility, all of which have associated pumps, valves, sampling connections, etc., and therefore, fugitive emissions from equipment leaks. Also, several different types of hazardous waste typically are managed at a facility. Because of the various factors affecting facility fugitive emissions from equipment leaks (e.g., equipment leak emissions are a function of component counts rather than waste throughput), it would be very difficult to determine a small-facility exemption based on risk but expressed as volume throughput. For these reasons, EPA did not include exemptions for fugitive emission monitoring such as those applied in the benzene NESHAP or SOCMI NSPS (i.e., small process units with the design capacity to produce less than 1,000 Mg/yr).

*Comment:* Commenters stated that the TSDF fugitive emission standards should conform to the benzene NESHAP, which allows exemptions for vacuum systems, systems with no emissions, and systems whose leakage rate is demonstrated to be below 2 percent.

*Response:* The EPA has included in the final TSDF standards (§§ 264.1050 and 265.1050) the exemption for equipment "in vacuum service" found in the benzene NESHAP (40 CFR part 61, subpart V, 61.242–1). Also included are the identification requirements contained in the regulation. "In vacuum service" means that equipment is operating at an internal pressure that is at least 5 kPa below ambient pressure. The EPA has concluded that it is unnecessary to cover equipment "in vacuum service" because such equipment has little if any potential for emissions and, therefore, does not pose a threat to human health and the environment. Accordingly, this equipment has been excluded from the equipment leak fugitive emission requirements.

The proposed standards stated that owners and operators of facilities subject to the provisions of the rule must comply with the requirements of 40 CFR part 61, subpart V (equipment leak standards for hazardous air pollutants), except as provided in the rule itself. The provisions of the proposed rule did not exclude §§ 61.243–1 and 61.243–2 (alternative standards for valves in VHAP service), and the alternative standards have been incorporated as §§ 264.1061, 264.1062, 265.1061, and 265.1062 of the final rule. Therefore, an owner or operator may elect to have all valves within a TSDF hazardous waste management unit comply with an alternative standard that allows a percentage of valves leaking of equal to or less than 2 percent (§§ 264.1061 and 265.1061), or may elect for all valves within a hazardous waste management unit to comply with one of the alternative work practices specified in paragraphs (b) (2) and (3) of §§ 264.1062 and 265.1062.

*Comment:* One commenter suggested that releases from pressure relief devices in gas service should be directed to control equipment at least equal in performance to those for other process sources or an alternative means provided to prevent an uncontrolled discharge. According to the commenter, rupture discs or closed-vent systems restrict small leaks but not major releases; a closed-vent system connected to a control device is needed to capture releases. The commenter concluded that EPA has provided no data to support exempting flanges and pressure relief devices in liquid service from LDAR requirements and should not rely on operators to see, hear or smell leaks from this equipment.

*Response:* Pressure relief devices allow the release of vapors or liquids until system pressure is reduced to the normal operating level. The standards are geared toward control of routine low-level equipment leaks that may occur independently of emergency discharges. Pressure relief discharges are an entirely different source of emissions than equipment leaks or process vents and were not covered in the original equipment leak standards under the CAA. The new subpart BB rules require that pressure relief devices in gas service be tested annually by Method 21 (and within 5 days of any relief discharge) to ensure that the device is maintained at no detectable emissions by means of a rupture disc. In addition, because a pressure discharge constitutes a process upset that in many cases can lead to hazardous waste management unit downtime and might also pose a risk to workers, a facility has the incentive to minimize the occurrence of these events.

The frequency, duration, and air emissions associated with such emergency discharges at TSDF waste management units currently cannot be estimated with any certainty on a nationwide basis. However, if a pressure discharge does occur, records and reports (maintained at the site under §§ 264.1054, 264.1064, 265.1054, and 265.1064 of subpart BB) will indicate the frequency of such discharges, the estimated volume of excess emissions and other relevant information. If pressure discharges appear to be a problem at any facility the RCRA permitting system provides State or EPA permit writers the flexibility to require closed-vent systems for these discharges on a site-specific basis.

The LDAR program transferred from the CAA standards does not exempt pressure relief devices in light liquid or heavy liquid service and flanges, but requires formal monitoring of these sources if operators see, smell, or hear discharges. The EPA considers that this is the most practical way to manage these sources. Although scheduled routine maintenance may be a way of avoiding the need for formal monitoring, it may not be a successful method for all sites in eliminating leaks due to the numerous variables affecting leak occurrence. For example, flanges may become fugitive emission sources when leakage occurs due to improperly chosen gaskets, poorly assembled flanges, or thermal stress resulting in the deformation of the seal between the flange faces. In these situations, operators will be able to detect such leaks by sight, smell, or sound. Support for this approach was presented and evaluated in developing several CAA rulemakings (EPA–450/3–83–016b, EPA–450/3–80–033b, and EPA–450/3–81–015b).

*Comment:* One commenter stated that the LDAR program should require preventive maintenance, such as the periodic replacement of valve packings, before waiting for the valve to fail. In support, the commenter argued that EPA's own data show that directed maintenance could reduce leaks from valves to below 10,000 ppm. The commenter also criticized the 10,000-ppm leak definition as being too high and states that EPA must consider the level in terms of the health effects.

*Response:* The key criterion for selecting a leak definition is the overall mass emission reduction demonstrated to be achievable. The EPA has not concluded that an effective lower leak definition has been demonstrated. Most data developed for current CAA standards (EPA–450/3–82–010) on leak repair effectiveness have applied 10,000 ppm as the leak definition and therefore do not indicate the effectiveness of repair for leak definitions between 1,000 and 10,000 ppm. Even though limited data between these values were collected for support of CAA standards, they are not sufficient to support a leak definition below 10,000 ppm. Data are insufficient to determine at what screening value maintenance efforts begin to result in increased emissions.

As the commenter noted, although there is some evidence that directed maintenance is more effective, available data are insufficient to serve as a basis for requiring directed maintenance for all sources.

(Note: In "directed maintenance" efforts, the tightening of the packing is monitored simultaneously and is continued only to the extent that it reduces emissions. In contrast, "undirected" repair means repairs such as tightening valve packings without simultaneously monitoring the result to determine whether the repair is increasing or decreasing emissions.)

The EPA's rationale for selecting the 10,000-ppmv leak definition and for not requiring directed maintenance under the CAA LDAR program also has been discussed in the proposal and promulgation BIDs for benzene emissions from coke by-product recovery plants (EPA–450/3–83–016 a and b), for SOCMI fugitive emissions (EPA–450/3–80–033 a and b), for petroleum refinery fugitive emissions (EPA–450/3–81–015 a and b), and for benzene fugitive emissions (EPA–450/3–80–032 a and b). (See also the "Response to Public Comments on EPA's Listing of Benzene Under section 112" (EPA–450/5–82–003) "Fugitive Emission Sources of Organic Compounds—Additional Information on Emissions, Emission Reductions, and Costs" (EPA–450/3–82–010), and EPA's "Response to Petition for Reconsideration" (50 FR 34144, August 23, 1985).)

The commenter also criticizes EPA for not reanalyzing the health effects of the 10,000-ppmv level before applying the limit to TSDF under RCRA. Because section 112 of the CAA and 3004(n) of RCRA are comparable in their recognition of health risk as the predominant decision factor, the EPA believes that the leak definition has been adequately analyzed under the CAA and that further evaluation is not needed prior to transferring it as part of the LDAR program under RCRA. It must also be pointed out that transfer of the CAA equipment leak standards is only the first phase of EPA's regulatory actions related to control of TSDF air emissions. In thisphase, EPA transferred a known technology to reduce emissions. If new data show that a lower leak definition is appropriate, EPA will then consider whether it is appropriate to change the rules.

## *C. Control Technology*

### Feasibility of Condensers

*Comment:* Several commenters did not agree that condensers provide a feasible means of meeting the 95-percent emission reduction requirement for affected process vents in the proposed standard. Problems cited by the commenters limiting the application of condensers included the presence of water in the waste stream in the TSDF portion of the facility and the wide variety of waste solvents treated by WSTF. One commenter claimed that a higher emission reduction efficiency could be achieved through an increased condenser area or a different condenser refrigerant with a lower boiling point than was used in the analysis for the proposal.

*Response:* In response to this comment, the feasibility of using condensers to achieve a 95-percent reduction of emissions from WSTF process vent streams was reexamined using a state-of-the-art chemical engineering computerized process simulator that includes a refrigeration unit capable of producing a coolant at a temperature as low as −29 °C (−20 °F) and a primary water-cooled heat exchanger to remove water vapor from the vent stream.

A variety of chemical constituents and operating conditions were examined to determine the organic removal efficiency achievable through condensation. The constituents selected for the condenser analysis (toluene, methyl ethyl ketone (MEK), 1,1,1 trichloroethane (TCE), and methylene chloride) were judged to be representative of the solvents recycled by the WSTF industry, based on a review of a National Association of Solvent Recyclers (NASR) survey, numerous site-specific plant trip reports, and responses to EPA section 3007 information requests. Three of these four solvents had been used in the proposal analysis; methylene chloride, at the lower end of the solvent boiling point range (i.e., more difficult to condense), was added to provide a broader range of volatilities for the condenser analysis. A total of 40 WSTF model unit cases consisting of combinations of organic emission rates, concentrations, and exhaust gas flows representing the wide range of operating conditions found at WSTF were included in the condenser analysis.

The results of the condenser analysis indicate that condensers cannot universally achieve a 95-percent emission reduction when applied to WSTF process vents. With regard to increasing organic removal efficiency by increasing condenser area or changing the condenser refrigerant, the analysis shows that there are technical limits on condenser efficiency that go beyond the condenser design and operating parameters. Specifically, the physical properties of the solvents being condensed and the solvent concentration in the gas stream affect condenser efficiency. In some situations, the partial pressure of the organic constituent in the vapor phase was too low to support a liquid phase thermodynamically regardless of the refrigerant used or condensation area; as a result, no appreciable condensation could occur. Therefore, the analysis shows that condensers are not universally applicable to the control of WSTF process vents. However, the facility process vent emission reduction requirements are not based solely on the use of condensers; carbon adsorption and incinerators/flares are capable of attaining a 95-percent control efficiency for all WSTF organics, including cases where condensation is not feasible. In summary, although condensers may not by themselves achieve a 95-percent emission reduction at all process vents, condensers do provide a practical and economic means of reducing process vent emissions, and these devices will likely be the initial choice of control technology for cases where condensation is feasible.

### Feasibility of Carbon Adsorbers

*Comment:* Several commenters objected to the identification of carbon adsorption as a control technique because of technical and safety concerns related to the application of carbon adsorbers to low organic concentration and multicomponent solvent streams. However, one commenter did cite authorities that support a 98-percent removal for this type of control device.

*Response:* First it should be noted that carbon adsorption is one of several control technologies that could be used to attain the standards. Other technologies include condensers, flares, incinerators, and any other device that the owner or operator can show will meet the standards.

Regarding carbon adsorption applications, EPA acknowledges that safety is an important consideration, but concludes that any safety problems can be avoided through proper design and sorbent selection. Multicomponent systems potentially can lead to excessive heat buildup (hot spots), particularly in large carbon beds with low flow rates, which in turn can lead to fire and explosion hazards. Multicomponent vapor streams can also lead to reduced removal efficiencies for particular components. However, these technical and efficiency problems can be overcome through proper design, operation, and maintenance.

In general, coal-based carbons have fewer heat generation problems than do wood-based carbons, and small diameter beds promote good heat transfer. The bed must be designed with consideration for the least heat adsorbent (or fastest) component in the mix, as well as the component concentrations and overall flow rate. Other considerations include component interaction, gas stream relative humidity, and close monitoring of the bed effluent for breakthrough.

In response to these comments, the EPA examined carbon adsorption design, operation, and performance data from a number of plants in a wide variety of industries; in addition, the EPA has reexamined, with the help of carbon manufacturers and custom carbon adsorption equipment designers, the elements that affect carbon adsorption efficiency. This analysis has reinforced EPA's original conclusion that a well-designed, -operated, and -maintained adsorption system can achieve a 95-percent control efficiency for all organics under a wide variety of stream conditions over both short-term and long-term averaging periods. The major factors affecting performance of an adsorption unit are temperature, humidity, organics concentration, volumetric flow rate "channelling" (nonuniform flow through the carbon bed), regeneration practices, and changes in the relative concentrations of the organics admitted to the adsorption system. The WSTF/TSDF process vent stream characteristics are typically well within design limits in terms of gas temperature, pressure, and velocity for carbon adsorbers. For example, the bed adsorption rate decreases sharply when gas temperatures are above 38 °C (100 °F); a review of plant field data showed no high-temperature streams in WSTF/TSDF process vents. If high-temperature gas streams are encountered, the gas stream can be cooled prior to entering the carbon bed. Also, gas velocity entering the carbon bed should be low to allow time for adsorption to take place. The WSTF/TSDF stream flows are typically quite low and, as a result, bed depth should not be excessive.

Therefore, EPA concluded that, for WSTF/TSDF process vent streams, carbon adsorption can reasonably be expected to achieve a 95-percent control efficiency provided the adsorber is supplied with an adequate quantity of high-quality activated carbon, the gas stream receives appropriate conditioning (e.g., cooling or filtering) before entering the carbon bed, and the carbon beds are regenerated or replaced before breakthrough. The data gathered in the EPA carbon adsorption performance study do not support a higher control efficiency (i.e., 98 percent as opposed to 95 percent) for carbon adsorption units applied to WSTF/TSDF process vents on an industrywide basis, particularly in light of the design considerations related to controlling multicomponent vent streams when the organic mix is subject to frequent change.

When carbon adsorption is used to remove organics from a gas stream, the carbon must periodically be replaced or regenerated when the capacity of the carbon to adsorb organics is reached. When either regeneration or removal of carbon takes place, there is an opportunity for organics to be released to the atmosphere unless the carbon removal or regeneration is carried out under controlled conditions. There would be no environmental benefit in removing organics from an exhaust gas stream using adsorption onto activated carbon if the organics are subsequently released to the atmosphere during desorption or during carbon disposal. The EPA therefore expects that owners or operators of TSDF using carbon adsorption systems to control organic emissions take steps to ensure that proper emission control of regenerated or disposed carbon occurs. For on-site regenerable carbon adsorption systems, the owner or operator must account for the emission control of the desorption and/or disposal process in the control efficiency determination. In the case of off-site regeneration or disposal, the owner or operator should supply a certification, to be placed in the operating file of the TSDF, that all carbon removed from a carbon adsorption system used to comply with subparts AA and BB is either (1) regenerated or reactivated by a process that prevents the release of organics to the atmosphere. (Note: The EPA interprets "prevents" as used in this paragraph to include the application of effective control devices such as those required by these rules) or (2) incinerated in a device that meets the performance standards of subpart O.

## Feasibility of Using Controls in Series

*Comment:* One commenter stated that EPA should evaluate carbon adsorption in series with a condenser because condensers work best with concentrated streams and carbon adsorbers with low concentration streams. The two systems together could yield an overall efficiency of 99 percent, even if each unit were only 90-percent effective.

*Response:* As discussed in section VII.E, the MIR from process vents after control (i.e., $4 \times 10^{-6}$) is within the range of what has been considered acceptable under RCRA. Consequently, no further control for process vents was considered necessary at this time. Nonetheless, in response to these comments, EPA evaluated the feasibility of using a carbon adsorber in series with a condenser to control WSTF/TSDF process vent emissions. The objective of the analysis was to determine if the combination of control devices would yield an overall control efficiency greater than the 95 percent that is achievable using a single device. For example, if a 99-percent overall control efficiency is desired and it is assumed that the carbon adsorber is capable of achieving a 95-percent control efficiency in all cases (a reasonable assumption for a properly designed, operated, and maintained system), then a minimum efficiency of 80 percent would be required for the condenser followed in series by the 95-percent efficient carbon bed. However, in the EPA condenser analysis conducted for the WSTF model unit cases, an 80-percent control was not achieved for 18 of the 40 cases examined. (See section 7.7 of the BID.) In 7 of the 40 cases, the analysis showed that no appreciable condensation would occur because of low solvent concentration and/or the high volatility of some solvents. Because the model unit cases are considered representative of current WSTF operations, EPA does not believe that the use of carbon adsorption and condensation in series to achieve a 99-percent control is a technically feasible control option on an industrywide basis. Such control strategies will be considered further for Phase III standards for individual facilities, if necessary, should additional analyses reveal unexpectedly high risks in specific situations.

## Feasibility of Flares

*Comment:* Several commenters objected to the use of flares at recycling facilities because of technical and safety concerns. A few commenters cite the requirement of a constant emission source for efficient flare operation, and other commenters contend that flares are not suitable on intermittent sources or the low-level emissions typical of recycling operations. With regard to safety, flares present the danger of explosion, especially if they malfunction; according to one commenter, many State laws prohibit the use of flares at recycling facilities.

*Response:* Available information on WSTF operations indicates that condensers, carbon adsorbers, and incinerators are the most widely used control technologies; therefore, they are expected to be the technologies of choice to reduce organic emissions at WSTF. The final technical analyses show that a 95-percent control efficiency can be achieved with secondary condensers for many WSTF process vents or with carbon adsorbers in cases where secondary condensers are not feasible. Flares are not required controls, but are an available option for facilities so equipped provided they meet the criteria established in the final rules. Where State laws prohibit the use of flares at recycling facilities, other technologies are available.

With regard to the safety of flares, EPA has determined that the use of flares to combust organic emissions from TSDF process vents would not create safety problems if engineering precautions such as those used in the SOCMI are taken in the design and operation of the system. The following are typical engineering precautions. First, the flare should not be located in such proximity to a process unit being vented that ignition of vapors is a threat to safety. In the analysis conducted for this standard at proposal, it was assumed that the flare would be located as far as 122 meters from the process unit. Second, controls such as a fluid seal or flame arrestor are available that would prevent flashback. These safety precautions were considered in EPA's analysis for the proposed rule. Finally, the use of a purge gas, such as nitrogen, plant fuel gas, or natural gas and/or the careful control of total volumetric flow to the flare would prevent flashback in the flare stack caused by low off-gas flow.

### Feasibility of LDAR Program

*Comment:* One commenter opposed the fugitive standards as proposed because they failed to require the proper technology to control releases from pumps and valves. The commenter claimed that the standards should require a 100-percent control, based on what available technology (e.g., sealed bellows valves, sealless pumps, or dual mechanical seals for pumps) can achieve. According to the commenter, superior emission controls cannot be rejected under RCRA solely on the basis of cost effectiveness.

*Response:* Control technologies for fugitive emissions from equipment leaks, as required by the proposed standards, include the use of control equipment, inspection of process equipment, and repair programs to limit or reduce emissions from leaking equipment that handle streams with total organic concentrations of greater than 10 percent. These control technologies have been studied and evaluated extensively by EPA for equipment containing fluids with 10 percent or more organics and are similar to those required by national emission standards for chemical, petrochemical, and refining facilities under the CAA.

A monthly LDAR program was proposed for WSTF/TSDF pumps and valves. Based on results of the EPA's LDAR model, once a monthly monitoring plan is in place, emission reductions of 73 percent and 59 percent can be expected for valves in gas and light liquid service, respectively, and a 61-percent reduction in emissions can be achieved for pumps in light-liquid service. For compressors, the use of mechanical seals with barrier fluid systems and control of degassing vents (95 percent) are required, although compressors are not expected to be commonly used at WSTF/TSDF. The use of control equipment (rupture disc systems or closed-vent systems to flares or incinerators) is the technical basis for control of pressure relief devices. Closed purge sampling is the required control for sampling connection systems and is the most stringent feasible control. For open-ended valves or lines the use of caps, plugs, or any other equipment that will close the open end is required; these are the most stringent controls possible. Flanges and pressure relief devices in liquid service are excluded from the routine LDAR requirements but must be monitored if leaks are indicated. For operations such as those expected at WSTF/TSDF, total reductions in fugitive emissions from equipment leaks of almost 75 percent are estimated for the entire program.

The EPA agrees with the commenter that the level of control required by the LDAR program does not result in the highest level of control that could be achieved for fugitive emissions from pumps and valves in certain applications. In some cases, there are more stringent, technologically feasible controls. For example, leakless equipment for valves, such as diaphragm and sealed bellows valves, when usable, eliminates the seals that allow fugitive emissions; thus, control efficiencies in such cases are virtually 100 percent as long as the valve does not fail. In appropriate circumstances, pumps can be controlled by dual mechanical seals that would capture nearly all fugitive emissions. An overall control efficiency of 95 percent could be achieved with dual mechanical seals based on venting of the degassing reservoir to a control device.

With regard to leakless valves, the applicability of these types of valves is limited for TSDF, as noted by EPA in the proposal preamble. The design problems associated with diaphragm valves are the temperature and pressure limitations of the elastomer used for the diaphragm. It has been found that both temperature extremes and process liquids tend to damage or destroy the diaphragm in the valve. Also, operating pressure constraints will limit the application of diaphragm valves to low-pressure operations such as pumping and product storage facilities.

There are two main disadvantages to sealed bellows valves. First, they are, for the most part, only available commercially in configurations that are used for on/off valves rather than for flow control. As a result, they cannot be used in all situations. Second, the main concern associated with this type of valve is the uncertainty of the life of the bellows seal. The metal bellows are subject to corrosion and fatigue under severe operating conditions.

Over 150 types of industries are included in the TSDF community, and EPA does not believe that leakless valves can be used in an environmentally sound manner on the wide variety of operating conditions and chemical constituents found nationwide in TSDF waste streams, many of which are highly corrosive. Corrosivity is influenced by temperature and such factors as the concentration of corrosive constituents and the presence of inhibiting or accelerating agents. Corrosion rates can be difficult to predict accurately; underestimating corrosion can lead to premature and catastrophic failures. Even small amounts (trace quantities) of corrosives in the stream can cause corrosion problems for sealed bellows valves; these tend to aggressively attack the metal bellows at crevices and cracks (including welds) to promote rapid corrosion. Sealed bellows valves particularly are subject to corrosion because the bellows is an extremely thin metallic membrane.

At proposal, it was estimated that 20 percent of all plants process halogenated compounds, which tend to be highly corrosive. The subsequently obtained 1986 Screener Survey data show that, of the TSDF indicating solvent recovery operations, at least 33 percent of the total handle halogenated organics. Furthermore, of the 12 major chemicals determined from site-specific data to be commonly occurring in waste solvent streams, all of the chemicals determined to be carcinogenic are halogenated (i.e., methylene chloride, chloroform, and carbon tetrachloride). Similarly, of the 32 constituents in TSDF waste streams contributing to the emission-weighted unit risk factor, about 30 percent are halogenated and account for the vast majority of the estimated nationwide emissions of carcinogens. Thus, TSDF are known to routinely handle and treat chemicals that may destroy sealed bellows and diaphragm valves.

The durability of metal bellows is highly questionable if the valve is operated frequently; diaphragm and bellows valves are not recommended in the technical literature for general service. The EPA does not believe that the application of sealed bellows and diaphragm valves is technologically feasible for all TSDF valve conditions or that their application would lead to a significant reduction in emissions and health risks. Valve sizes, configurations, operating temperatures and pressures, and service requirements are some of the areas in which diaphragm, pinch, and sealed bellows valves have limitations that restrict service. With regard to the emission reductions achieved by sealed bellows, diaphragm, and pinch valve technologies, these valves are not totally leakless. The technologies do eliminate the conventional seals that allow leaks from around the valve stem; however, these valves do fail in service from a variety of causes and, when failure occurs, these valves can have significant leakage. This is because these valves generally are not backed up with conventional stem seals or packing. The EPA currently is reevaluating the control efficiencies assigned to these technologies. Because these leakless types of equipment are limited in their applicability and in their potential for reducing health risks, EPA did not consider their use as an applicable control alternative at this time for nationwide TSDF standards. The EPA has requested, in a separate Federal Register notice (54 FR 30220, July 19, 1989), additional information on the applicability and use of leakless valves at TSDF.

For pumps, the most effective controls that are technologically feasible (e.g., dual seals) in some cases also were not selected as the basis for equipment leak standards. The impact analysis indicates that including LDAR results in less emission and risk reduction than does including equipment requirements for pumps. However, the difference in the emission and health risk reductions attributable to implementing a monthly LDAR program rather than the more stringent equipment standards for pumps appears to be small in comparison to the results of the overall standards (about 5 percent). The overall standards, including a LDAR program for pumps and valves, would achieve an expected emission reduction for TSDF equipment leaks of about 19,000 Mg/yr (21,000 ton/yr). The estimated MIR from equipment leak emissions would be reduced to $1\times10^{-3}$ from $5\times10^{-3}$ based on the TSDF equipment leak emission-weighted unit risk factor; cancer incidence would be reduced to 0.32 case/yr from 1.1 cases/yr. In comparison, including dual seals for pumps could achieve an additional fugitive emission reduction of about 1,200 Mg/yr (1,320 ton/yr) and an additional incidence reduction of about 0.06 case/yr. The MIR, with leakless controls for pumps, at $1\times10^{-3}$ would be unchanged from that achieved by the LDAR program.

Given the small magnitude and the imprecise nature of the estimated emission and risk reductions associated with including dual seals for pumps in the overall standard, EPA considers the two control alternatives (i.e., LDAR and dual seals) as providing essentially the same level of protection. The data and models on which the risk estimates are based are not precise enough to quantify risk meaningfully to a more exact level. The data and models include uncertainties from the emission estimates, the air dispersion modeling, and the risk assessment that involves unit risk factor, facility location, population, and meteorologic uncertainties (see section VII.E).

The EPA considered these factors when deciding whether to require TSDF to install dual seals on pumps to control air emissions rather than to rely on monthly LDAR. Considering the limited applicability of additional equipment controls and the low potential for additional reductions in health risks of applying equipment controls for valves at TSDF and the estimated emissions and risk reductions if leakless equipment for pumps were required, EPA is not requiring leakless equipment at this time.

In Phase III, EPA will further examine the feasibility and impacts of applying additional control technology beyond the level required by today's standards. For example, dual mechanical seals may be an appropriate emission control method when applied selectively to wastes with high concentrations of toxic chemicals. In such applications, the reduction in toxic emissions (and consequently the reduction in residual risk) may be significant for select situations. A summary of the health impacts is presented in section VII.E of this preamble.

### *D. Impact Analyses Methodologies*

### Environmental Impacts Analysis

*Comment:* Numerous commenters criticized the environmental impact estimates for the proposed standards because (1) no actual data from operating facilities were used; (2) emission estimates were not supported by any technical data base; and (3) the waste constituents used in the analyses were not representative of waste solvent recycling operations and TSDF operations in general. Commenters also stated that the model plant solvent reclamation rates (throughputs), vent flow rates, and emission rates used at proposal were not representative of the industry.

*Response:* In response to these comments, EPA reviewed all available site-specific data on WSTF and TSDF, data submitted by commenters, and information generated through RCRA section 3007 questionnaires mailed to a limited number of small and large facilities. Based on all this information, EPA has revised both the TSDF model units and emission factors that serve as the bases for the impacts analyses.

With regard to the model unit revisions, the industry profile developed by EPA includes a frequency distribution of the waste volumes processed during 1985. Of the 450 facilities in the Screener Survey reporting solvent recovery by operations such as batch distillation, fractionation, or steam stripping that involved some form of hazardous waste, 365 reported the total quantity of waste recycled in 1985. The median facility throughput was slightly more than 189,000 L/yr (50,000 gal/yr); the mean throughput was about $4.5\times10^{6}$ L/yr ($1.2\times10^{6}$ gal/yr). Based on the industry profile, three sizes of model units (small, medium, and large) were defined to facilitate the post-proposal analyses for control costs, emission reductions, health risks, and economic impacts.

The organic emission rates also were revised for the model units based on emission source testing conducted for EPA. The test data show that organic emission rates for primary condensers varied from a few hundredths of a kilogram (pound) to nearly 4.5 kg/h (10 lb/h), with six of the nine measurements less than 0.45 kg/h (1 lb/h). The two secondary condensers tested showed emission rates of 0.9 and 2.3 kg/h (2 and 5 lb/h), respectively.

The flow rate of 28 standard cubic feet per minute (scfm) used at proposal was found not to be generally valid for application to waste solvent recyclers. The flow rates specified for the revised model units, 3.8, 0.6, and 0.3 L/s, equivalent to 8.1, 1.2, and 0.6 scfm for the large, medium, and small model units, respectively, are based on a review of site-specific data from field tests documented in site visit reports. The large and medium TSDF process vent unit flow rates also agree with those documented in the SOCMI Distillation NSPS BID (see Docket No. F–86–AESP, item S0008) as characterizing distillation units with low overhead gas flows. The revised impact analyses are based on actual data from the industry and provide a reasonable characterization of the industry's operations and environmental impacts.

The constituents selected for the analysis of control technologies are considered to be representative of the industry, based on a review of relevant information and literature, including (1) a survey of member companies submitted by NASR, (2) 23 site-specific plant visit reports, (3) responses to the EPA section 3007 Questionnaires from 6 small and 11 large facilities (two respondents provided information for 4 facilities each), (4) the Industrial Studies Data Base (ISDB) and (5) a data base created by the Illinois EPA. The NASR survey provided information on the types of solvents most frequently recycled at member facilities; the site-specific information and EPA survey responses included waste composition data. The ISDB is a compilation of data from ongoing, in-depth surveys by EPA's Office of Solid Waste (OSW) on designated industries that are major waste generators. The Illinois EPA data base contains information from about 35,000 permit applications. Generators must submit one application for each hazardous and special nonhazardous waste stream managed in the State of Illinois. Each of these data bases contains waste stream characterization data for numerous generic spent solvent waste streams (EPA Hazardous Wastes F001–F005) and D001 wastes (ignitable), which information from the Screener Survey indicates also are recycled.

The three constituents used for the model facilities in the proposal analysis were toluene (with a boiling point (bp) of 110 °C), MEK (bp of 79 °C), and TCE (bp of 74 °C). Methylene chloride (bp of 40 °C) was added to the list of constituents evaluated in the final analysis to provide an even greater range of solvent volatilities for the analysis. Therefore, the technical feasibility and costs of applying the recommended control techniques were evaluated for constituents representing the range of characteristics and volatilities of commonly recycled solvents at TSDF.

*Comment:* Commenters also stated that it is inappropriate to apply the fugitive emission factors to TSDF that were developed to estimate leaks from a typical hydrocarbon plant because they do not relate to the design, operating conditions, maintenance practices, or controls associated with processing of waste solvents and other toxic wastes. According to the commenters, the emission factors and model units also need adjustment to account for volatility because not accounting for differences in vapor pressure overestimates risk as well as emissions and underestimates costs for controls.

*Response:* The EPA disagrees; the data used in establishing the fugitive emission standards for TSDF are based on emission and process data collected at a variety of petroleum refinery and SOCMI operating units. The EPA Industrial Environmental Research Laboratory (IERL) coordinated a study to develop information on fugitive emissions in the SOCMI. A total of 24 chemical process units were tested; these data covered thousands of screened sources (pumps, valves, flanges, etc.) and included units handling such chemicals as acetone, phenol, MEK, ethylene dichloride, TCE, trichloroethylene, and perchloroethylene.

Refinery studies on fugitives also include tests on units handling both toluene and xylene. These same chemicals are included in those listed by the NASR as solvents commonly recycled by member facilities and are found in other sources of waste solvent constituent information that are described in the BID. The chemicals commonly recycled at TSDF are those produced in SOCMI operating units and handled in petroleum refineries, and the equipment involved in these industries is typically the same (pumps, valves, etc.). Therefore, it is reasonable to conclude that the emissions associated with these chemicals and equipment are similar and to expect similar emission control performance and efficiencies at hazardous waste management units.

The EPA agrees that the equipment leak standards should take component volatility into consideration. Previous EPA and industry studies have shown that the volatility of stream components, as a process variable, does correlate with fugitive emission and leak rates. An analysis of the vapor pressures and emission rates has shown that substances with vapor pressures of 0.3 kPa or higher had significantly higher emission and leak rates than did those with lower vapor pressures (EPA–450/3–82–010). This result led to the separation of equipment component emissions by service: gas/vapor, light liquid, and heavy liquid. These classifications have been used in most CAA fugitive emission standards to effectively direct the major effort toward equipment most likely to leak. Therefore the rules have been revised to account for volatility. For example, pumps and valves in heavy-liquid service must be monitored only if evidence of a potential leak is found by visual, audible, olfactory, or any other detection method. The determination of light- and heavy-liquid service is based on the vapor pressure of the components in the stream (less than 0.3 kPa at 20 °C defines a heavy liquid).

All of the constituents used in the model unit analysis, representing the ranges of characteristics of commonly recycled solvents, are light liquids to which the benzene and SOCMI fugitive emission factors are applicable. Therefore, the revised risk and cost analyses for WSTF equipment leak fugitive emissions are based on the fugitive emission factors used in the proposal analysis. The analyses of risk and cost impacts on TSDF with affected fugitive emission sources also were revised after proposal to account for the differences in light and heavy liquids.

Health Risk Impacts Analysis

*Comment:* Several commenters objected to the limited support provided for selection and derivation of the unit risk factors used in the analysis of cancer risks and contend that the risk analysis and unit risk factors are not representative of the wide variety of wastes handled. A few of the commenters stated that the upper-bound risk factor was too high, and others stated it was too low.

*Response:* The selection of the range of unit risk factors (i.e., $2\times10^{-7}$ and $2\times10^{-6}$ $(\mu g/m^3)^{-1}$ used at proposal to estimate the cancer risk resulting from TSDF emissions was based on an analysis of the organic chemicals associated with TSDF operations. This analysis found that carbon tetrachloride is the organic chemical with the most individual impact vis-a-vis emissions and risk. Thus, it was used as the upper bound on the range of unit risk factors used to calculate health impacts (i.e., cancer risk) at proposal. However, this range of unit risk factors was not used in the final analysis.

Based on public comments, EPA revised its health risk impacts analysis. To estimate the cancer potency of TSDF air emissions in the revised analysis, an emission-weighted composite unit cancer risk estimate approach was used by EPA to address the problem of dealing with the large number of toxic chemicals that are present at many TSDF. Use of the emission-weighted composite factor rather than individual component unit cancer risk factors simplifies the risk assessment so that calculations do not need to be performed for each chemical emitted. The composite unit cancer risk factor is combined with estimates of ambient concentrations of total organics and population exposure to estimate risk due to nationwide TSDF emissions. In calculating the emission-weighted average unit risk factor, the emission estimate for a compound is first multiplied by the unit cancer risk factor for that compound; then the emission-weighted average is computed by summing these products and dividing the sum by the total nationwide TSDF emission value, which includes both carcinogenic and noncarcinogenic organic emissions. Using this type of average would give the same results as calculating the risk for each chemical involved. However, only those carcinogens for which unit risk factors are available were included in the analysis of cancer risk under this approach.

Through use of the EPA's TSDF Waste Characterization Data Base (WCDB) (discussed in appendix D of the BID) and a computerized model developed for analysis of the regulatory options for TSDF emission sources, EPA estimated total nationwide TSDF organic emissions by specific waste constituent. Thirty-nine chemicals were identified as TSDF organic air pollutant emission constituents emitted from equipment leaks at all types of TSDF waste management processes. Unit cancer risk factors for these constituents were then averaged based on both individual constituent and total nationwide TSDF equipment leak organic emissions to calculate an emission-weighted composite mean TSDF cancer unit risk factor.

Numerous constituents with higher unit risk factors than carbon tetrachloride (including acrylonitrile and ethylene oxide) were included in the calculation of the emission-weighted unit cancer risk factor for TSDF equipment leaks. This emission-weighted unit risk factor value was determined to be $4.5\times10^{-6}$ $(\mu g/m^3)^{-1}$ and was used to determine the health-related impacts associated with TSDF equipment leak (fugitive) emissions rather than the range of the unit cancer risk factors used at proposal that represented a limited number of chemical compounds emitted at WSTF. A more detailed discussion of the hazardous waste TSDF unit risk factor determination is contained in appendix B of the BID.

Characterization of WSTF waste streams in the final analysis indicates that the constituents used at proposal in the risk analysis are appropriate and representative of the waste solvent recycling industry. However, insufficient nationwide data on WSTF (a subset of the TSDF industry) waste stream chemical constituent quantities and concentrations were available to develop an emission-weighted, arithmetic mean cancer unit risk factor for WSTF process vents. While information on a small number of process vent streams was available for the revised analysis, the data were too limited to support the conclusion that the mix and percentage of constituents found were representative of the entire industry.

The WSTF waste streams and their associated process vent emissions were found to contain a variety of chemical constituents. Those constituents with established risk factors were, in all cases for the plant-specific data, the halogenated organics; these halogenated organic constituent concentrations tended to be quite low, generally less than 1 percent of organics emitted. Therefore, EPA judged, based on the limited data available, that use of a midrange unit risk factor would be appropriate in estimating nationwide health impacts associated with WSTF process vents. The unit cancer risk factor assumed at proposal, $2\times10^{-6}$ $(\mu g/m^3)^{-1}$, was the geometric midrange between the highest and lowest unit risk factor for the constituents found in the WSTF process vent streams. The composite unit cancer risk factor calculated for the equipment leak emissions agrees favorably with the process vent number used at proposal. Because it is not unreasonable to assume a similar mix of constituents in process vents as in equipment leaks, and because available data do not suggest otherwise, for the purpose of estimating impacts, the same unit cancer risk factor was used for both process vents and equipment leaks, $4.5\times10^{-6}$ $(\mu g/m^3)^{-1}$.

*Comment:* Several commenters also stated that the failure to address the weight of evidence for carcinogenicity is inconsistent with EPA's risk assessment guidelines and the principles for assessing cancer risk.

*Response:* Early in the rulemaking for TSDF, EPA looked at the contribution to total estimated risk (annual incidence) by weight of evidence. At that time, "C" carcinogens accounted for about 1 percent of the total risk, and "A" carcinogens about 10 percent. Thus, for all practical purposes, calculating separate risk estimates for chemicals in each weight of evidence category adds little to the risk assessment. Moreover, EPA's Guidelines for Carcinogen Risk Assessment (51 FR 33992) and Guidelines for the Health Risk Assessment of Chemical Mixtures (51 FR 34014) do not describe a means to quantitatively incorporate weight of evidence into risk assessments. Thus, there is no inconsistency between the risk assessment guidelines and the presentation of health risk in this rulemaking.

*Comment:* Other commenters believed that the risk assessment for the proposed standards was flawed because EPA did not consider noncancer health effects and because large uncertainties are introduced when the additive or synergistic effects of carcinogens and the interindividual variability in response are not factored in.

*Response:* The EPA does recognize that health effects other than cancer may be associated with both short-term and long-term human exposure to the organic chemicals emitted to the air at WSTF/TSDF. The EPA believes, however, that a risk assessment based on cancer serves as the clearest basis for evaluating the health effects associated with exposure to air emissions from TSDF. A quantitative assessment of the potential nationwide noncancer health impacts (e.g., developmental, neurological, immunological, and respiratory effects) was not conducted due to deficiencies at this time in the health data base for these types of effects.

Although unable to numerically quantify noncancer health risks, EPA did conduct a screening analysis of the potential adverse noncancer health effects associated with short-term and long-term exposure to individual waste constituents emitted from TSDF. This analysis was based on a comparison of relevant health data to the highest short-term or long-term modeled ambient concentrations for chemicals at each of two selected TSDF. (A detailed presentation of the screening analysis is contained in the BID, appendix B.)

Results of this analysis suggest that adverse noncancer health effects are unlikely to be associated with acute or chronic inhalation exposure to TSDF organic emissions. It should be noted that the health data base for many chemicals was limited particularly for short-term exposures. The conclusions reached in this preliminary analysis should be considered in the context of the limitations of the health data; the uncertainties associated with the characterization of wastes at the facilities; and the assumptions used in estimating emissions, ambient concentrations, and the potential for human exposure. Additional evaluation of noncancer health effects may be undertaken as part of the third phase of the TSDF regulatory program. To that effect, in the proposal preamble for the Phase II TSDF air rules, EPA is specifically requesting comments from the public on methodologies and use of health data for assessing the noncancer health effects of TSDF organic emissions. In addition, because there is a potential for cancer and noncancer health effects from TSDF chemicals from indirect pathways such as ingestion of foods contaminated by air toxics that have deposited in the soil, EPA will evaluate the need to include an indirect pathway element in the TSDF health risk analysis in the future.

The EPA is aware of the uncertainties inherent in predicting the magnitude and nature of toxicant interactions between individual chemicals in chemical mixtures. In the absence of toxicity data on the specific mixtures of concern, and with insufficient quantitative information on the potential interaction among the components (i.e., additivity, synergism, or antagonism), the EPA has assumed additivity to estimate the carcinogenicity of the mixtures of concern. This is consistent with guidance provided in the 1986 "EPA Guidelines for the Health Risk Assessment of Chemical Mixtures" (51 FR 34014).

The EPA also recognizes that there are uncertainties associated with the variability of individual human responses following exposures to toxicants. As stated in the 1986 "EPA Guidelines for Carcinogen Risk Assessment" (51 FR 33992) human populations are variable with respect to genetic constitution, diet, occupational and home environment, activity patterns, and other cultural factors. Because of insufficient data, however, the EPA is unable to determine the potential impact of these factors on the estimates of risk associated with exposure to carcinogens emitted from TSDF.

### Cost Impacts Analysis

*Comment:* Various commenters questioned the cost estimates used in the analysis for carbon adsorbers and condensers as well as the nationwide recovery credits for WSTF and TSDF. Commenters contend that the costs for carbon adsorbers estimated at proposal are low because a device is needed for each vent if manifolding is not practiced as a result of (1) the potential for cross-contamination of new or recycled materials and (2) additional incurred costs when the carbon is regenerated or disposed of.

*Response:* In response to these comments EPA evaluated controls for 40 model unit cases representing ranges and combinations of solvent physical properties, total flow rates, and organic concentrations in the vent stream. Both carbon canisters and fixed-bed regenerable carbon systems were costed for process vent streams where condensers would not achieve a 95-percent reduction because of stream conditions. The analysis showed that, for a stream with an emission rate greater than 0.45 kg/h (1 lb/h), a carbon bed can achieve the same emission reduction at lower cost than can a carbon canister. Thus, there is a level of emissions at which the facility owner or operator for economic reasons will switch from the use of replaceable carbon canisters to the use of a fixed-bed regenerable carbon adsorption system. The capital costs (1986 $) of the fixed-bed regenerable carbon systems ranged from $97,300 up to $202,000, and annual operating costs ranged from $40,200 to $43,500 (from $33,100 to $43,100 when a recovery credit is included). The capital cost (1986 $) of a carbon canister was $1,050, and annual operating costs ranged from $7,890 to $24,800 (carbon canisters are not regenerated on site and a recovery credit is not included). The fixed-bed, regenerable carbon system operating costs include regeneration/disposal of spent carbon; carbon canister operating costs include carbon replacement and disposal. Thus, these costs were used in conducting the final impact analyses.

With regard to the requirement of a control device for each vent, EPA acknowledges that there are instances where vent manifolding is not allowed because of potential product contamination. However the product has already been recovered from the process prior to exhaust gases passing to the vents, which are sources of organic emissions to the atmosphere; therefore, manifolding of the vent streams should not lead to a product contamination problem.

In the absence of the site-specific information needed to determine control device requirements, for the purposes of estimating cost impacts, it was assumed in the revised analysis that one control device would be needed per WSTF. Although this assumption may underestimate the control cost for a facility that chooses to install carbon adsorbers on more than one vent, it is potentially a very small underestimate because the total annual cost of a carbon canister, for example, is comprised almost totally of annual operating costs, which are directly proportional to the emissions removed. Thus the potential underestimate in total annual cost resulting from assuming one carbon adsorber per facility is not significant. Furthermore, the addition of the process vent emission limit to the rules based on the total facility emission rate lessens the likelihood that a facility will need to control multiple process vents to attain the allowable emission rate of 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 ton/yr).

Several commenters also questioned the nationwide cost credit for secondary condensers estimated at proposal, stating that secondary condensers actually would result in substantial costs and that the cost estimates do not account for the more sophisticated systems needed in high-humidity areas to allow for equipment deicing or water removal. In response to concerns regarding the estimated condenser yields and the requirement for more sophisticated systems in high-humidity areas, EPA utilized a state-of-the-art computerized process simulator known as the Advanced System for Process Engineering (ASPEN) for reevaluating analyses of condenser design and cost. The ASPEN condenser configuration included an optional primary water-cooled heat exchanger to reduce the size of the refrigeration unit and to remove water vapor in order to avoid freezing problems because the condenser temperature is low enough to cause ice buildup on heat transfer surfaces. Therefore, the revised cost estimates account for water removal.

The model unit cases represent industrywide ranges and combinations of vent stream characteristics. For the large model unit cases (3.9 L/s total flow rate), total annual cost with recovery credit ranged from a credit of $4,980 up to a net of no cost. For the medium model unit cases (0.6 L/s total flow rate), the total annual cost with recovery credit ranged from $630 up to $2,000. For the small model unit cases (0.3 L/s total flow rate), the total annual cost with recovery credit ranged from $1,770 up to $2,000. Therefore, in many cases, the use of secondary condensers does result in positive costs; these costs, however do not result in adverse economic impacts.

The model unit control cost estimates and the WSTF industry profile were used to generate nationwide control cost estimates of implementing the process vent regulations. The cost estimates are for 73 large facilities and 167 medium facilities. The 208 small facilities (less than 189,000 L (50,000 gal) throughput/yr as defined in the post-proposal analysis) would not have to install additional controls because their emissions are less than the facility process vent cutoff.

Because there was insufficient site-specific information available to determine which facilities could apply condensation rather than carbon adsorption, upper- and lower-bound estimates were generated. The upperbound cost estimate is based on the assumption that fixed-bed, regenerable carbon adsorption systems would be required to control process vents at all facilities with emissions above the emission rate cutoff. Similarly the lower-bound cost estimate is based on the assumption that condensers could be used to control process vents at all facilities with emissions above the emission rate cutoff. The range in estimates of nationwide total annual cost is from a credit of $68,000 up to a cost of $12.9 million, assuming the installation of one control device per facility.

Finally, EPA agrees that a recovery credit is not applicable to TSDF in general because most of the hazardous wastes handled at TSDF are destined for disposal. In contrast, at a WSTF, the air emissions resulting from equipment leaks are potentially recyclable solvents. Thus, no recovery credit was applied for TSDF other than WSTF in the analyses for the final equipment leak standards.

### *E. Implementation and Compliance*

### Test Methods

*Comment:* Commenters argued that the test methods proposed for use in determining whether waste streams contain more than 10 percent total organics are inappropriate primarily because they do not measure volatile organics. One commenter objected to the use of weight percent when defining "in VHAP service" based on liquid sample analyses.

*Response:* The EPA recognized that each of the various test methods proposed for determining the organic content of waste streams had limitations and that none was universally applicable. The determination of subpart BB applicability should not require precise measurement of the 10 percent total organics by weight in most cases. The EPA anticipates that most waste streams will have an organic content much lower or much higher than 10 percent. Furthermore, because the regulation requires control if the organic content of the waste stream ever equals or exceeds the 10-percent value, EPA believes that few owners or operators will claim that a waste stream is not subject to the requirements of the standard based on a sample analysis with results near 10 percent. Therefore, a precise measurement of waste stream total organic content is not likely to be needed to determine applicability of the equipment leak standards.

If the facility does decide to test the waste, the choice of the appropriate method must be based on a knowledge of the process and waste. The EPA has prepared a guidance document that includes information to aid TSDF owners/operators and enforcement and permitting personnel in implementing the regulations. Additional detail is provided in the guidance document to aid in choosing the most appropriate test method. (Refer to "Hazardous Waste TSDF—Technical Guidance Document for RCRA Air Emission Standards for Process Vents and Equipment Leaks." EPA–450/3–89–21.)

In response to the commenters' concerns that volatility of the waste stream should be considered, the LDAR provisions of the regulation were changed to establish two potential levels of required monitoring. Those processes with the greater emission potential are designated to be in light-liquid service and are required to implement a more restrictive LDAR program. Those processes with a lesser emission potential are designated to be in heavy-liquid service and are required to implement a less restrictive LDAR program. The determination of being in light-liquid service is based on the concentration of organic components in a waste whose pure vapor pressure exceeds 0.3 kPa. This addresses the commenters' concerns that volatility of the waste stream should be considered. For the process vent portion of the regulation, if an organic is present at the vent, it is presumed to be volatile. Therefore, volatility is considered by virtue of where the determination of applicability is made.

With reference to the use of weight percent when defining "in VHAP service" (a term that has been dropped from the promulgated regulations), EPA believes that weight percentage is the unit of choice when the determination of organic content is made on a solid, liquid, or sludge waste. It is also commonly associated with those types of wastes. For gaseous streams that exceed 10 percent organics by weight, the commenter's point is well taken. Volume fractions are more commonly reported for gaseous streams. However, it is not easier to calculate the volume percent rather than weight percent. Additional information on the calibration standard used, the carrier gas in the standard, and both the organic and other inorganic gases in the sample are required in both cases. For simplicity, the units of the standard are uniformly weight percent regardless of waste type.

### Implementation Schedule

*Comment:* Several commenters objected to the time periods contained in the proposed standards for implementation schedules and requested that EPA not dictate a step-by-step schedule.

*Response:* The EPA agrees with the commenters that EPA should not dictate step-by-step implementation schedules for installing the control devices and closed-vent systems required to comply with these regulations because each affected facility needs some flexibility to budget funds, perform engineering evaluations, and complete construction. Therefore, EPA has dropped the interim dates in the schedule and retained only the final period of 2 years from the promulgation for completing engineering design and evaluation studies and for installing equipment. The final rules require that all affected facilities comply with the standards on the effective date; however, the rules allow up to 24 months from the promulgation date (i.e., 18 months after the effective date) for facilities to comply if they are required to install a control device and they can document that installation of the emission controls cannot reasonably be expected to be completed earlier. Existing waste management units that become newly regulated units subject to the provisions of subpart AA or BB because of a new statutory or regulatory amendment under RCRA (e.g., a new listing or identification of a hazardous waste) will have up to 18 months after the effective date of the statutory or regulatory amendments that render the facility subject to the provisions of subparts AA or BB to complete installation of the control device. New hazardous waste management units starting operation after the effective date of subparts AA and BB must meet the standards upon startup. This subject is discussed further in section IX. Implementation, of this preamble. The final standards require that both permitted and interim status facilities maintain the schedules and the accompanying documentation in their operating records. The implementation schedule must be in the operating record on the effective date of today's rule, which is 6 months after promulgation. No provisions have been made in the standards for extensions beyond 24 months after promulgation.

### Permitting Requirements

*Comment:* Several commenters suggested that RCRA part B information requirements be limited to the units already included in the part B application. Units that must comply with this regulation because the facility is subject to RCRA permit requirements for other reasons should not be required to be added to the part B permit application. Other commenters objected to statements in the preamble regarding the role of the omnibus permitting authority under RCRA section 3005(c)(3). The commenters questioned the absence of criteria for establishing when such authority would be applied to require more stringent controls and argued that authorizing permit writers to impose more stringent controls based on unenforceable guidance is not a substitute for regulations.

*Response:* The EPA is aware that extending specific part B information requirements to those hazardous waste management units that are not subject to RCRA permitting but are located at facilities that are otherwise subject to RCRA permit requirements could result in the need for those facilities to modify RCRA permits or their part B applications. However, EPA believes that extending the part B information requirements to hazardous waste management units not subject to RCRA permitting is necessary to ensure compliance with the subpart AA and subpart BB standards.

The EPA also agrees that requiring a modification of RCRA permits (and part B applications) as part of this rule could result in delays in processing and issuing final RCRA permits. Therefore, the final rules do not require facilities to modify permits issued before the effective date of these rules. Consistent with 40 CFR 270.4, a facility with a final permit issued prior to the effective date is generally not required to comply with new part 264 standards until its permit is reissued or reviewed by the Regional Administrator. Hazardous waste management units and associated process vents and equipment affected by these standards must be added or incorporated into the facility permit when the permit comes up for review under § 270.50 or reissue under § 124.15. As previously noted, EPA intends to propose to modify this policy in the forthcoming Phase II rules such that permitted facilities must comply with the interim-status air rules.

Facilities that have obtained RCRA interim status, as specified in 40 CFR 270.70 (i.e., compliance with the requirements of section 3010(a) of RCRA pertaining to notification of hazardous waste activity and the requirements of 40 CFR 270.10 governing submission of part A applications), will be subject to the part 265 standards on the effective date. Interim status facilities that have submitted their part B application prior to the effective date of the regulation will be required to modify their part B applications to incorporate today's requirements.

The omnibus permitting authority of § 270.32 allows permit writers to require, on a case-by-case basis, emission controls that are more stringent than those specified by a standard. The EPA has a mandate to use this authority for situations in which regulations have not been developed or in which special requirements are needed to protect human health and the environment. For example, this authority could be used in situations where, in the permit writers judgment, there is an unacceptably high risk after application of controls required by an emission standard. This aspect of the permitting process is discussed further in section IX of this preamble. The EPA is currently preparing guidance to be used by permit writers to help identify facilities that would potentially have high residual risk due to air emissions. The guidance will include procedures to be used to identify potentially high-risk facilities and will include guidance for making a formal, site-specific risk assessment.

### Recordkeeping and Reporting

*Comment:* Commenters asked EPA to include a provision in the final standards to provide for the elimination of recordkeeping requirements that may be duplicative of State or Federal requirements for equipment leaks. Commenters also asked whether TSDF are subject to any notification requirements if their waste stream is less than 10 percent organics.

*Response:* The EPA agrees that duplicative recordkeeping and reporting should generally be eliminated to the extent possible. Because of the difficulties in foreseeing all situations in which this could occur, a provision to this effect has not been added to the final standards. However, when records and reports required by States are substantially similar, a copy of the information submitted to the State will generally be acceptable to EPA. When similar records and reports are required by other EPA programs (such as the visual observations required for pumps and valves associated with storage tanks and incinerators), EPA suggests that owners or operators of TSDF coordinate monitoring and recordkeeping efforts to reduce labor and costs. One set of records should be maintained with emphasis on the more detailed monitoring records required by these standards. The EPA considers that the monitoring required for equipment leaks under these standards differs significantly from the monitoring required for ground water protection purposes under other RCRA rules. However, the monitoring and recordkeeping programs can be combined for efficiency.

There are no notification requirements in the equipment leak rules for waste streams that have been determined never to exceed 10 percent total organics by weight.

## VII. Summary of Impacts of Final Standards

### *A. Overview of the Source Category*

Hazardous waste TSDF are facilities that store, treat, or dispose of hazardous wastes. A TSDF may generate and manage hazardous waste on the same site, or it may receive and manage hazardous waste generated by others.

The EPA has conducted a number of surveys to collect information about the TSDF industry. The most recent of these surveys, the 1986 National Screening Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities, lists more than 2,300 TSDF nationwide. Available survey data further indicate that the majority (96 percent) of waste managed at TSDF is generated and managed on the same site and identifies more than 150 different industries, primarily manufacturing, that generate hazardous waste. Approximately 500 TSDF are commercial facilities that manage hazardous waste generated by others.

The types of wastes managed at TSDF and the waste management processes used are highly variable from one facility to another. The physical characteristics of wastes managed at TSDF include dilute wastewaters (representing more than 90 percent by weight of the total waste managed), organic and inorganic sludges, and organic and inorganic solids. Waste management processes differ according to waste type and include storage and treatment in tanks, surface impoundments, and wastepiles; handling or storage in containers such as drums, tank trucks, tank cars, and dumpsters; and disposal of waste in landfills, surface impoundments, injection wells, and by land treatment. In addition, hazardous waste may be managed in "miscellaneous units" that do not meet the RCRA definition of any of the processes listed above. Hazardous waste may also be handled in research, development, and demonstration units as described in 40 CFR 270.65.

The promulgated standards limit organic emissions from (1) hazardous waste management unit process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, and air and stream stripping operations that manage waste with 10 ppmw or greater total organics concentration, and (2) leaks from equipment at new and existing hazardous waste management units that contain or contact hazardous waste streams with 10 percent or more total organics. The final equipment leak standards apply to each pump valve, compressor, pressure relief device, sampling connection, open-ended valve or line, flange, or other connector associated with the affected hazardous waste management unit. About 1,400 facilities are estimated to be potentially subject to the equipment leak standards (i.e., TSDF managing hazardous waste containing at least 10 percent organics). Of these, 450 are estimated to have process vents subject to the vent standards in subpart AA.

### *B. Use of Models in the Regulatory Development Process*

In estimating baseline (i.e., unregulated) emissions, emission impacts of the regulatory options, and control costs for the options for equipment leaks, EPA made use of a combination of analytical and physical models of waste management processes. This approach was selected because insufficient facility-specific data are available to conduct a site-specific characterization of the entire TSDF industry. For example, the physicalmodels of waste management processes (or units) were used as simplified representations of the equipment component mix expected to be associated with each particular hazardous waste management process. The model unit provides an estimate of the number of pumps, valves, open-ended lines, pressure relief valves, and sampling connections that are used in the waste management process. Although these models are not exact for each type of process, they provide a reasonable approximation of what can be expected on average; precise equipment counts for each unit at each facility are not available.

In the absence of sufficient site-specific data, EPA developed a model to calculate nationwide health, environmental, and cost impacts associated with hazardous waste TSDF. Details of the national impacts model can be found in the BID, appendix D. This national impacts model was used to estimate the nationwide impacts necessary for comparison of the various TSDF equipment leak emission control options. The national impacts model is a complex computer program that uses a wide variety of information and data concerning the TSDF industry to calculate nationwide impacts through summation of approximate individual facility results. Information processed by the model includes results of TSDF industry surveys as well as characterizations and simulations of TSDF processes and wastes, emission factors of each type of management unit, the efficiencies and costs of emission control technologies, and exposure and health impacts of TSDF pollutants. This information is contained in several independent data files developed by EPA for use as inputs to the model. These data files are briefly described below.

Industry profile data identify the name, location, primary standard industrial classification (SIC) code, waste management processes, waste types, and waste volumes for each TSDF. The industry data were obtained from three principal sources: A 1986 National Screening Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities; the Hazardous Waste Data Management System's RCRA part A permit applications; and the 1981 National Survey of Hazardous Waste Generators and Treatment, Storage, and Disposal Facilities Regulated Under RCRA. The industry data are used in the model to define the location and the SIC code for each facility and to identify the waste management units at each facility as well as the types and quantities of waste managed in each unit.

The hazardous waste characterization consists of waste data representative of typical wastes handled by facilities in each SIC code. The waste data are linked to specific facilities by the SIC code and the RCRA waste codes identified for that facility in the industry profile. The waste characterization data include chemical properties information that consists of constituent-specific data on the physical, chemical, and biological properties of a group of surrogate waste constituents that were developed to represent the more than 4,000 TSDF waste constituents identified in the waste data base. The surrogate categories were defined to represent actual organic compounds based on a combination of their vapor pressures, Henry's law constants, and biodegradability. The use of surrogate properties was instituted to compensate for a lack of constituent-specific physical and chemical property data and to reduce the number of chemicals to be assessed by the model.

The emission factors data consist of emission factors, expressed as emissions per unit of waste throughput, for each combination of surrogate waste constituent and model waste management process. Each model waste management process was, in effect, a "national average model unit" that represented a weighted average of the operating parameters of existing waste management units. The EPA's LDAR model was used to develop emission control efficiencies and emission reductions for the TSDF equipment leak emission factors used in the analysis. This LDAR model is based on the Agency's extensive experience with equipment leaks in the petrochemical and synthetic organic chemical manufacturing industries.

Incidence data consist of estimates of annual cancer incidence for the population within 50 km of each TSDF. This information was developed using EPA's Human Exposure Model, 1980 census data, and local meteorological data summaries. Because some of the data used in the national impacts model are based on national average values rather than actual facility-specific data, maximum risk numbers generated by the model are not considered to be representative of facility-specific risks. Maximum individual risk has meaning only at the facility level. Therefore, EPA chose to use another methodology for estimating MIR for equipment leaks. This is discussed further in section VII.E.

Data related to emission control technologies and costs include information that describes control efficiencies, capital investment, and annual operating costs for each emission control option that is applicable to a particular waste management process. These data were obtained through engineering analyses of control device operations and the development of engineering cost estimates.

To make use of all of these data, the national impacts model contains procedures that (1) identify TSDF facilities, their waste management processes, waste compositions, and annual waste throughputs; (2) assign chemical properties to waste constituents and assign control devices to process units; and (3) calculate uncontrolled emissions, emissions reductions, control costs, and health impacts. Results produced by the model include, on a nationwide basis, uncontrolled emissions, controlled emissions, capital investment costs, annual operating costs, annualized costs for controls, and annual cancer incidence. As previously stated, these nationwide values are obtained by summing the results of individual facility analyses across all facilities.

The primary objective and intended use of the national impacts model are to provide reasonable estimates of TSDF impacts on a nationwide basis. Because of the complexity of the hazardous waste management industry and the current lack of detailed information for individual TSDF, the model was developed to utilize national average data where site-specific data are not available. As a result, the estimated emissions and cancer incidence from the model do not represent the impacts for a specific individual facility. However, with national average data values used where site-specific data were missing, EPA believes that the estimates are reasonable on a nationwide basis and are adequate for decisionmaking.

### *C. Emission Impacts*

Since proposal in February 1987, EPA has reviewed all available site-specific information and data on WSTF and TSDF, much of which has only become available since proposal. For example, EPA is conducting a multiyear project to collect information on the Nation's generation of hazardous waste and the capacity available to treat, store, dispose of, and recycle that waste. The initial phase of the project was the 1986 National Screening Survey of Hazardous Waste Treatment, Storage, Disposal and Recycling Facilities, which identified and collected summary information from all hazardous waste treatment, storage, disposal, and recycling facilities in the United States. The results of this "Screener Survey" together with data from other existing data bases (such as the Hazardous Waste Data Management System's RCRA part A applications; the National Survey of Hazardous Waste Generators and Treatment, Storage, and Disposal Facilities Regulated Under RCRA in 1981; the Industry Studies Database; a data base of 40 CFR 261.32 hazardous wastes from specific sources; the WET Model Hazardous Waste Data Base; and a data base created by the Illinois EPA) were used to support the development and analysis of these air emission regulations for hazardous waste TSDF. Additional sources of data on TSDF and waste solvent recycling operations included EPA field reports on hazardous waste facilities and responses to RCRA section 3007 information requests sent to a limited number of both large and small facilities. Based on all of this information, EPA has revised and expanded the impact analyses, including estimates of emissions, risks, costs, and the economic impact on small businesses and on the industry as a whole.

Using the revised impact analyses, nationwide (unregulated) baseline equipment leak organic emissions from TSDF waste streams of 10 percent or greater total organics are estimated at 26,200 Mg/yr. This estimate includes equipment leak emissions from waste solvent treatment facilities and from other TSDF with hazardous waste management processes handling wastes with organic concentrations of 10 percent or greater, a total of about 1,400 facilities. The bases for these estimates are contained in the BID, appendix D.

Nationwide (unregulated) organic emissions from process vents at about 450 TSDF with solvent recovery operations range from 300 Mg/yr (based on lower-bound emission rates) to 8,100 Mg/yr (based on upper-bound emission rates). This wide emission range occurs because of variations in primary condenser recovery efficiencies and the use of secondary condensers at some sites. The lower-bound rate represents high recovery efficiencies at all facilities, and the upper-bound rate represents low recovery efficiencies at all facilities. Actual nationwide emissions should fall between these values.

With the implementation of the standards, nationwide TSDF equipment leak emissions will be reduced to about 7,200 Mg/yr; nationwide organic emissions from process vents will be reduced to a range from 270 Mg/yr (lower-bound emission rates) to 900 Mg/yr (upper-bound emission rates).

### *D. Ozone Impacts*

Reductions in organic emissions from TSDF sources will have a positive impact on human health and the environment by reducing atmospheric ozone formation as a result of reductions in emissions of ozone precursors, primarily organic compounds. Ozone is a major problem in most larger cities, and EPA has estimated that more than 100 million people live in areas that are in violation of the ambient ozone standards. Ozone is a pulmonary irritant that can impair the normal functions of human lungs, may increase susceptibility to bacterial infections, and can result in other detrimental health effects. In addition, ozone can reduce the yields of citrus, cotton, potatoes, soybeans, wheat, spinach, and other crops, and can cause damage to conifer forests and a reduction in the fruit and seed diets of wildlife. Because TSDF organic emissions account for about 12 percent of total nationwide organic emissions from stationary sources, today's rules will contribute to a reduction in ozone-induced health and environmental effects and will assist in attainment and maintenance of the ambient air quality standards for ozone. Table 1 summarizes the emissions and health risk impact estimates.

Ozone precursors and chlorofluorocarbons, whose emissions will be reduced by this rulemaking, are both considered greenhouse gases (i.e., gases whose accumulation in the atmosphere has been related to global warming). Although the regulation's direct impact on global warming has not been quantified, the direction being taken is a positive one. Implementation of these rules will reduce tropospheric ozone, which contributes to global warming.

### *E. Health Risk Impacts*

Human health risks posed by exposure to TSDF air emissions are typically quantified in two forms: Annual cancer incidence and MIR. Annual cancer incidence is the estimated number of cancer cases per year due to exposure to TSDF emissions nationwide. The MIR, on the other hand, represents the potential risk to the one hypothetical individual who lives closest to a reasonable worst-case TSDF for a lifetime of 70 years. The MIR is derived from modeling a reasonable worst-case scenario and is not based on actual measurement of risk. It is not representative of the entire industry, and, in fact, may be experienced by few, if any, individuals. As explained in appendix B of the BID, there are great uncertainties in both these types of health risk estimates. These two health risk forms were used as an index to quantify health impacts related to TSDF emissions and emission controls. As discussed in section VI.D., an equipment-leak-specific, emission-weighted unit risk factor of $4.5 \times 10^{-6}$ $(\mu g/m^3)^{-1}$ was used to estimate the nationwide annual cancer incidence and the MIR of contracting cancer associated with TSDF equipment leak organic emissions. See appendix B of the BID for a detailed analysis of the health risk impacts.

At proposal, order-of-magnitude health impacts were estimated for cancer risks from exposure to organic air emissions from WSTF and TSDF. The Human Exposure Model (HEM) was used to calculate the magnitude of risks posed by WSTF at both typical and maximum emission rates. Based on an estimated urban/rural distribution, EPA selected six WSTF to represent the nationwide WSTF industry in performing the risk assessment. Using the results of the analysis of these "typical" facilities, health impacts were extrapolated to all WSTF and TSDF in general to provide nationwide estimates.

In the revised health impacts analysis for the final rules, annual cancer incidence and MIR were again used to quantify health impacts for the control alternatives for process vents and equipment leaks. However, in this followup analysis, the HEM was run using site-specific data on facility waste throughputs, emission rates, meteorology, and population density for each WSTF and TSDF nationwide identified in the various data bases.

The facility-specific information was obtained from three principal sources. Waste quantity and solvent recycling data were taken from the 1986 National Screener Survey; waste management processing schemes and waste types managed in each facility were based on the Hazardous Waste Data Management System's (HWDMS) RCRA part A applications; the National Survey of Hazardous Waste Generators and Treatment, Storage, and Disposal Facilities Regulated Under RCRA in 1981 (Westat Survey); and the 1986 National Screener Survey.

In revising the methodology applied in assessing cancer risks, EPA conducted facility-specific HEM computer runs for nearly all of the 448 WSTF that reported, in the 1986 National Screener Survey, recycling and/or reuse of solvents and other organic compounds (i.e., TSDF expected to have the specified process vents) and for each of the more than 1,400 TSDF in the industry profile of 2,300 TSDF that were determined to manage wastes with at least 10 percent organic content. These HEM results were used to estimate nationwide cancer incidence for both TSDF equipment leaks and process vents.

The nationwide annual incidence resulting from uncontrolled TSDF equipment leaks is estimated at 1.1 cases of cancer per year. Based on the estimated lower-bound emission rates, the nationwide cancer incidence from uncontrolled process vents is 0.015 case/yr. Based on the upper-bound emission rate, the incidence from process vents is 0.38 case/yr. With the application of the final process vent standards, based on lower-bound emission rates, the annual cancer incidence will be reduced to 0.001 from 0.015 case/yr. Based on upper-bound emission rates, annual incidence will be reduced to 0.027 case/yr from 0.38 case/yr. With the implementation of the LDAR programs for equipment leak emissions, the annual cancer incidence associated with fugitive emissions will be reduced to about 0.32 case/yr.

TABLE 1. SUMMARY OF NATIONWIDE ENVIRONMENTAL AND HEALTH RISK IMPACTS OF TSDF AIR EMISSION REGULATIONS

| ESDF source category | Nationwide emissions, Mg/yr | | Annual incidence [a], cases/yr | | Maximum individual risk [a] | |
|---|---|---|---|---|---|---|
| | Uncontrolled | Controlled | Uncontrolled | Controlled | Uncontrolled | Controlled |
| Process vents [b] | | | | | | |
| Lower bound | 300 | 270 | 0.015 | 0.001 | $3 \times 10^{-5}$ | $2 \times 10^{-6}$ |
| Upper bound | 8,100 | 900 | 0.38 | 0.027 | $8 \times 10^{-5}$ | $4 \times 10^{-6}$ |
| Equipment leaks | 26,200 | 7,200 | 1.1 | 0.32 | $5 \times 10^{-3}$ | $1 \times 10^{-4}$ |

[a] Annual incidence and MIR are based on an emission-weighted average unit risk factor for TSDF.

[b] The lower- and upper-bound process vent emission estimates reflect the range of primary condensers' removal efficiencies and the use of secondary condensers on some primary condenser vents.

The HEM results were also used to estimate the MIR for process vents. For estimates of MIR associated with TSDF equipment leaks, a separate methodology was used for reasons discussed below.

There are three major problems in applying the methodology used to estimate cancer incidence, a nationwide value, to estimate MIR from equipment leaks, a site-specific value. The first problem concerns the emission estimation technique. Equipment count, and not the amount of waste handled, is the major determining factor for emission estimates from equipment leaks. Equipment counts do not double or triple accordingly as throughput is increased. Because the size of the model plant (and thus the equipment count) assigned to a waste management process was based on the amount of waste handled, emissions from equipment leaks will be overstated for larger facilities and understated for smaller facilities. This averages out on a nationwide basis, but individual facility estimates are not considered accurate for estimates of MIR.

The second problem deals with the waste compositions and forms (e.g., wastewater and concentrated organics) attributed to each RCRA waste code (e.g., F001). A waste code may involve wastes in several forms. The determination of impacts was based on the national average waste form distribution for each particular waste code occurring at each facility. For example, if on average across the Nation, a particular organic waste solvent appears as an aqueous waste (very dilute organics) 20 percent of the time, as a sludge 50 percent of the time, and as an organic liquid 30 percent of the time, those percentages were applied to every facility that was identified to handle that type of waste regardless of the actual percentages of waste form found at the facility. In some cases, this resulted in larger facilities being assigned a much greater percentage of an organic liquid form than would actually be the case. Again, this averages out on a nationwide basis, but for site-specific estimates such as MIR more refined determinations are required.

The third problem with using the HEM for equipment leaks is that the HEM does not model area sources directly: it collocates all emission sources at one central point and models the emissions as point sources. This is appropriate for estimates for process vents that are actual point sources, but not for equipment leaks. A typical TSDF would have several hundred equipment components with the potential for leaks that could be located over the entire facility area.

In estimating MIR for equipment leaks, EPA based its hypothetical, reasonable worst-case facility, in large part, on an actual facility. The EPA was able to characterize the facility in sufficient detail that dispersion estimates could be generated using a true area source dispersion model. This was possible because more detailed site-specific information has become available on a limited basis since proposal. The preliminary results of a multiyear project to collect information on the Nation's generation of hazardous waste and the capacity available to treat, store, dispose of, and recycle that waste were used as the basis of the analysis. In the survey, all active treatment, storage, disposal, and recycling facilities (TSDR) were sent a detailed package of questionnaires appropriate to the processes they operate. The completed questionnaires were reviewed for technical accuracy; after independent verification, the information collected was entered into a complex data base. The TSDR survey questionnaire responses contain the most detailed up-to-date nationwide information regarding the hazardous waste management technologies each facility has on site. For each facility, detailed information is available in the data base, including facility area, numbers of hazardous waste management units by process type (i.e., number of surface impoundments, incinerators, recycling units), annual throughput by process unit, and types of waste (i.e., RCRA waste codes) managed by each unit at the facility. The availability of this information in computerized format made it possible to use the TSDR survey data base to identify facilities that represent the population of worst-case facilities with regard to equipment leak emissions and the potential for high MIR values. A detailed discussion of the health impacts methodologies is presented in appendix B of the BID.

The MIR estimate was made first by screening detailed TSDR Survey data for more than 1,400 TSDF to identify the facility that has the highest potential equipment leak emissions and the highest potential for these emissions to result in high ambient air concentrations (i.e., high emissions on a small facility area). Next, it was assumed that this facility handles hazardous wastes that have carcinogens with an emission-weighted potency equal to that of the nationwide average and that an individual was residing at the shortest distance from the TSDF management units to the nearest apparent residence. The highest annual-average ambient concentration, resulting from this high emission-rate facility, predicted to occur at the residence nearest the facility was then determined by dispersion modeling. The Industrial Source Complex Long-Term (ISCLT) dispersion model was used in the equipment leak MIR analysis to model the worst-case facility as a true area source with the actual facility area of about 1 acre as input. The highest annual average out of the results of 5 years of meteorological data modeled for each of the eight cities used to characterize nationwide meteorology was selected for use in the MIR calculation. Thus, this MIR estimate is considered a reasonable worst-case estimate for the industry and should not be interpreted to represent a known risk posed by any actual facility in the industry.

The MIR resulting from TSDF baseline (or uncontrolled) equipment leak emissions is estimated at $5 \times 10^{-3}$, i.e., 5 chances in 1,000. Based on the estimated lower-bound emission rates for process vents, the MIR for uncontrolled process vents is about 3 chances in 100,000 ($3 \times 10^{-5}$); based on the upper-bound emission rate, the MIR is $8 \times 10^{-4}$. Because of the uncertainties inherent in nationwide emission and risk estimates that must characterize the many different constituents present in a variety of TSDF operations, EPA considered the upper-bound estimates in its decisionmaking.

With the application of the final process vent standards, based on lower-bound emission rates, the MIR will be reduced to $2 \times 10^{-6}$ from $3 \times 10^{-5}$. Based on the upper-bound emission rates, the MIR will be reduced to $4 \times 10^{-6}$ from $8 \times 10^{-4}$. With the implementation of control requirements for equipment leak emissions that include monthly LDAR requirements for pumps and valves, caps for open-ended lines, closed-purge sampling, and rupture discs for pressure relief devices, the MIR associated with fugitive emissions will be reduced to about $1 \times 10^{-3}$ from $5 \times 10^{-3}$. Appendix B of the BID, EPA 450/3–89–009, presents a detailed explanation of the derivation of these risk estimates.

The MIR estimate for equipment leaks is sensitive to several factors. Emissions are the most obvious factor controlling risk. The facility associated with the reported MIR for equipment leaks is one of the highest emitting TSDF in terms of equipment leaks, in the upper 99.5 percent for potential equipment leak emissions. If the analysis were to use the 85-percentile emissions (i.e., 85 percent of the TSDF nationwide have lower equipment leak emissions than this value), then MIR would drop from $1 \times 10^{-3}$ to $5 \times 10^{-4}$ with all other factors held constant.

Another factor affecting the MIR estimates is area of the emitting source. For these types of sources, risk is inversely proportional to the area of the emitting source. For example, given equal emissions, a facility located over 10 acres generally poses less risk than a facility on 1 acre. For the facility presenting the highest risk in this rule, the MIR would drop from $1 \times 10^{-3}$ to $2 \times 10^{-4}$ if 10 acres were used in the estimate rather than 1 acre. It should also be pointed out that for the more than 1,400 TSDF surveyed in the EPA 1987 TSDR Survey, the median facility area was greater than 50 acres.

Distance to the nearest resident is another key variable in the risk estimate. The actual distance to the nearest residence (i.e., 250 ft) for the worst-case facility was used in calculating the reported MIR value; however, the median distance in a random sample of distances to the nearest residence reported in a survey of the hazardous waste generators was 1,000 ft. If this median distance were used in the estimate, even with the high emissions and the small area, the maximum risk value would drop from $1 \times 10^{-3}$ to $2 \times 10^{-4}$. Meteorology is also a factor; the worst-case dispersion was used in the reported estimate. If an average case were used, then risk would drop to $8 \times 10^{-4}$ with all other factors held constant.

As the above examples show, facilities with anything other than the combined worst-case factors would pose significantly less risk than the MIR reported for equipment leaks. The MIR estimates presented are, for the most part, based on worst-case or conservative assumptions; the one exception is the weighted-average cancer potency value, or unit risk factor (URF), used. The EPA believes it is unreasonable to make all worst-case assumptions for a single facility. However, because of the overall conservative nature of the analysis, for the industry as a whole, the vast majority of TSDF would pose significantly lower risk from equipment leak emissions than the reported reasonable, worst-case value.

### *F. Cost Impacts*

The EPA developed a detailed estimate of the total capital investment, annual operating costs, and total annual costs of each emission control technology applied to each affected waste management unit. Total capital investment represents the total original cost of the installed control device. Total annual cost represents the total payment each year to repay the capital investment for the control device as well as to pay for the control device (or work practice) operating and maintenance expenses. The costs of attaining the 95-percent control or emission reduction for process vents are based on the use of condensers to control process vent streams for which condensation is technically feasible and on the use of carbon adsorption systems to control the remaining process vent streams subject to the regulations. Because site-specific information was insufficient to determine which facilities could apply condensers rather than carbon adsorbers industry-wide, upper- and lower-bound cost estimates were generated for process vent controls. The upper-bound cost estimates are based on the assumption that fixed-bed, regenerable carbon adsorption systems would be required to control process vents at all facilities with emissions above the emission rate limit. Similarly, the lower-bound cost estimate is based on the assumption that condensers could be used to control process vents at all facilities with emissions above the emission rate limit.

The nationwide capital investment and total annual cost of implementing the requirements of today's rule for process vent controls are estimated at $24.6 million and $12.9 million/year, respectively, for the upper-bound case. For the lower-bound case, capital investment is $1.5 million and total annual costs represent a small savings of $70,000/yr. These costs are based on an industry profile that includes 73 large recycling facilities and 167 medium-sized recycling facilities. The more than 200 small recycling facilities are not included in the cost estimates because they are projected not to have to install additional controls to meet the facility emission rate limit.

The capital investment and total annual costs of controlling TSDF equipment leak emissions with the LDAR program together with some equipment specifications are estimated at $128.6 million and $32.9 million/yr, respectively. Table 2 summarizes capital and annual costs associated with the final rules.

Further information on the economic impacts of the final standards for organic control from TSDF process vents and equipment leaks is presented in section VIII of this preamble. Details of the analysis are presented in the BID, chapter 9.0.

TABLE 2.—SUMMARY OF NATIONWIDE COST IMPACTS OF TSDF AIR EMISSION REGULATIONS

| TSDF source category | Nationwide capital cost, $ millions (1986) | Nationwide annualized cost [a], $ millions/yr |
|---|---|---|
| Process vents [b] | | |
| Lower bound | 1.5 | (0.1) |
| Upper bound | 24.6 | 12.9 |
| Equipment leaks | 128.6 | 32.9 |

( ) indicates a cost credit.

[a] Includes a recovery credit for recycling. No recovery credit was applied for TSDF without recycling processes.

[b] The lower-bound cost estimates assume that condensers could be used to control process vents at all facilities with emissions above the emission rate limit; the upper-bound cost estimates assume that carbon adsorbers would be required to control process vents at all facilities with emissions above the emission rate limit.

## VIII. State Authorization

### *A. Applicability of Rules in Authorized States*

Under section 3006 of RCRA, EPA may authorize qualified States to administer and enforce the RCRA program within the State. (See 40 CFR part 271 for the standards and requirements for authorization.) Following authorization, EPA retains enforcement authority under sections 3008, 7003, and 3013 of RCRA, although authorized States have primary enforcement responsibility under section 7002.

Prior to the HSWA of 1984, a State with final authorization administered its hazardous waste program entirely in lieu of EPA administering the Federal program in that State. The Federal requirements no longer applied in the authorized State, and EPA could not issue permits for any facilities in the State that the State was authorized to permit. When new, more stringent Federal requirements were promulgated or enacted, the State was obliged to enact equivalent authority within specified timeframes. New Federal requirements did not take effect in an authorized State until the State adopted the requirements as State law.

In contrast, under section 3006(g)(1) of RCRA, 42 U.S.C. 6926(g), new requirements and prohibitions imposed by HSWA take effect in authorized States at the same time that they take effect in nonauthorized States. The EPA is directed to carry out those requirements and prohibitions in authorized States, including the issuance of permits, until the State is granted authorization to do so. While States must still adopt HSWA-related provisions as State law to retain final authorization, the HSWA requirements apply in authorized States in the interim.

### *B. Effect on State Authorizations*

Today's rule is promulgated pursuant to section 3004(n) of RCRA, a provision added by HSWA. Therefore, EPA is adding the requirements to Table 1 in 40 CFR 271.1(j), which identifies the Federal program requirements that are promulgated pursuant to HSWA and take effect in all States, regardless of authorization status. States may apply for either interim or final authorization for the HSWA provisions identified in Table 1, as discussed in this section of the preamble.

The EPA will implement today's rule in authorized States until (1) they modify their programs to adopt these rules and receive final authorization for the modification or (2) they receive interim authorization as described below. Because this rule is promulgated pursuant to HSWA, a State submitting a program modification may apply to receive either interim or final authorization under section 3006(g)(2) or section 3006(b), respectively, on the basis of requirements that are substantially equivalent or equivalent to EPA's. The procedures and schedule for State program modifications for either interim or final authorization are described in 40 CFR 271.21. It should be noted that all HSWA interim authorizations will expire automatically on January 1, 1993 (see 40 CFR 271.24(c)).

Section 271.21(e)(2) requires that authorized States must modify their programs to reflect Federal program changes and must subsequently submit the modifications to EPA for approval. The deadline for State program modifications for this rule is July 1, 1991 (or July 1, 1992, if a State statutory change is needed). These deadlines can be extended in certain cases (40 CFR 271.21(e)(3)). Once EPA approves the modification, the State requirements become subtitle C RCRA requirements.

A State that submits its official application for final authorization less than 12 months after the effective date of these standards is not required to include standards equivalent to these standards in its application. However, the State must modify its program by the deadlines set forth in 40 CFR 271.21(e). States that submit official applications for final authorization 12 months after the effective date of these standards must include standards equivalent to these standards in their applications. Section 271.3 sets forth the requirements a State must meet when submitting its final authorization application.

States that are authorized for RCRA may already have requirements under State law similar to those in today's rules. These State regulations have not been assessed against the Federal regulations being promulgated today to determine whether they meet the tests for authorization. Thus, a State is not authorized to implement these requirements in lieu of EPA until the State program modification is approved. Of course, States with existing standards may continue to administer and enforce their standards as a matter of State law. In implementing the Federal program, EPA will work with States under cooperative agreements to minimize duplication of efforts. In many cases, EPA will be able to defer to the States in their efforts to implement their programs rather than take separate actions under Federal authority.

## IX. Implementation

As proposed, the air emission standards for process vents and equipment leaks were included as subpart C of part 269, Air Emission Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities. Part 269 was to be added to the CFR with the promulgation of these standards. For consistency with standards for other TSDF sources under RCRA, the final standards have been incorporated into parts 264 and 265. Subpart AA applies to process vents and subpart BB to equipment leaks. In addition, whereas at proposal the equipment leak requirements of 40 CFR part 61, subpart V, were incorporated by reference, these provisions have been included in subpart BB with revisions appropriate for a standard promulgated under RCRA authority rather than CAA authority.

Under the current RCRA permitting system, a facility that has received a final permit must comply with all of the following requirements as specified in 40 CFR 270.4: (1) The specific conditions written into the permit (including conditions that demonstrate compliance with part 264 regulations); (2) self-implementing statutory requirements; and (3) regulations promulgated under 40 CFR part 268 restricting the placement of hazardous waste in or on the land. When new regulations are promulgated after the issuance of a permit, EPA may reopen the permit to incorporate the new requirements as stated in § 270.41. Otherwise, the new regulatory requirements are incorporated into a facility's permit at the time of permit reissuance, or at the 5-year review for land disposal facilities.

Facilities that have not been issued a final permit and that have fully complied with the requirements for interim status must comply with the regulations specified in CFR part 265. New regulations that are added to part 265 become applicable to interim status facilities on their effective dates.

Although EPA has the authority to reopen permits to incorporate the requirements of new standards, EPA is concerned about the resource burdens of this approach. To reopen permits for each new regulation at the time it is promulgated would impose a large administrative burden on both EPA and the regulated community because a major permit modification would generally require the same administrative procedures as are required for initial permits (e.g., development of a draft permit, public notice, and opportunity for public hearing). As a consequence, the requirements of new standards are usually incorporated into a permit when it is renewed. For standards implemented through the RCRA permit system, the effect of this policy is to "shield" facilities that have been issued a final permit from any requirements promulgated after the issuance of the permit until the time that the permit must be renewed and the new requirements are written into the permit. Thus, this policy is often referred to as the "permit-as-a-shield" policy. Although this policy is generally applied, EPA may evaluate the need to accelerate the implementation of standards developed under RCRA and, if warranted, make exceptions to the permit-as-a-shield policy. In today's rules, the permit-as-a-shield provision applies to control of air emissions from process vents and equipment leaks regulated under section 3004(n). However, as previously noted, in the Phase II TSDF air rules, EPA intends to propose modifications to permit-as-a-shield provisions as they apply to control of air emissions under these new subparts. With this proposed action, air rules promulgated under RCRA section 3004(n) would be applicable to all facilities, regardless of permit status.

Both interim status and permitted facilities must comply with the substantive control requirements of the final standards. However, facilities that have already been issued a final permit prior to the effective date of today's final rules are not required to comply with the rules until such time as the permit is reviewed or is reissued. Interim status facilities that have submitted their part B permit application are required to modify their part B applications to incorporate the requirements of today's rules.

The EPA considers that the part 265 standards promulgated here can be satisfied without the need for detailed explanation or negotiation between the facility owner/operator and EPA and therefore, interim status facilities can comply without awaiting permit action. The self-implementing nature of these rules is achieved by including specific criteria for facility owners or operators to identify waste management units that are subject to the regulation and by clearly specifying the emission control and administrative requirements of the rules.

The criteria for applicability are that certain hazardous waste management units at new and existing TSDF that need authorization to operate under RCRA section 3005 are covered by the rules. The applicability includes all hazardous waste management units and recycling units at facilities that require RCRA permits. For the equipment leak standards to apply, the equipment must contain or contact hazardous wastes with a 10-percent-or-more total organics concentration. For the process vent standards to apply, the vents must be associated with specific hazardous waste management units, i.e., distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations, that manage wastes with 10 ppmw or greater total organics concentration.

Control requirements in the final regulation include specific design requirements for equipment and specific performance criteria (i.e., a weight-percent reduction and a volume concentration limit) for emission control devices. Provisions of the final standards also list specific types of equipment required. Owners and operators who use one of the listed types of equipment within the specified design and operational parameters would therefore be in compliance with the regulation as long as the required design, inspection, monitoring, and maintenance provisions were met. Specifications for emission controls that achieve at least a 95-weight-percent reduction in volatile organic emissions are somewhat less specific, but engineering design practices are sufficiently established that the combination of a good control device design and subsequent monitoring of operating parameters, as required by the final regulation, would offer reasonable assurance that the specified emission reduction is being achieved. Regardless of the type of control selected, owners and operators must maintain their own records of control device design, installation, and monitoring and must submit reports identifying exceeders of monitored control device parameters. Periodic review of the required reports and records by EPA may be used to ensure compliance.

Because today's rules are promulgated under HSWA, all affected facilities must comply with these requirements on the effective date of the rule, regardless of the authorization status of the State in which they are located. In addition, because EPA will implement these rules in every State on the effective date, all reports should be sent to the EPA Regional Offices until the State receives authorization to implement these rules. Therefore, owners and operators of TSDF with existing waste management units subject to the provisions of subparts AA and BB must achieve compliance with the process vent and equipment leak control and monitoring requirements on the effective date of these rules (i.e., 6 months following promulgation) except where compliance would require the installation of a closed-vent system and control device. Information developed under other EPA regulations has shown that in some cases, the design, construction, and installation of a closed-vent system and control device can take as long as 24 months to complete. As a result, EPA is allowing up to 24 months from the promulgation date of the regulation for existing facilities to complete installation if they are required to install a closed-vent system and control device and if they can document that installation of the emission controls cannot reasonably be expected to be completed earlier. In these circumstances, owners/operators are required to develop an implementation schedule that indicates dates by which the design, construction, and operation of the necessary emission controls will be completed. This implementation schedule must document that installation of closed-vent systems and control devices required by the final standards would be achieved within a period of no more than 2 years from today and must be included as part of the facility's operating record on the effective date of these final rules (i.e., 6 months after promulgation). Changes in the implementation schedule are allowed within the 24-month timeframe if the owner or operator documents that the change cannot reasonably be avoided.

This extension would also apply to those existing facilities that are brought under regulation because of new statutory or regulatory amendments under RCRA that render the facility subject to the provisions of subpart AA or BB (e.g., units handling wastes newly listed or identified as hazardous by EPA). That is, the owner or operator may be allowed up to 18 months from the effective date of the statutory or regulatory amendment to complete installation of a control device. However, for facilities adding new waste management units, EPA believes that the lead time involved in such actions provides adequate time for owners and operators to design, procure, and install the required controls. Therefore, all new units must comply with the rules immediately (i.e., must have control equipment installed and operating upon startup of the unit).

Under the approach discussed above, the standards promulgated today for process vents and equipment leaks would be implemented on the following schedule for existing TSDF:

—180 days following promulgation, the new subparts AA and BB standards become effective; all facilities become subject to the new standards.

—On the effective date of the standards, compliance with the standards is required. Each facility that does not have the control devices required by the standards in place and operating must have one of the following in the facility's operating record: (1) An implementation schedule indicating when the controls will be installed, or (2) a process vent emission rate determination that documents that the emission rate limit is not exceeded (therefore, controls are not required).

—No later than 18 months following the effective date (2 years following promulgation), any control devices required by the standards for process vents and equipment leaks must be installed at all facilities.

—All permits issued after the effective date must incorporate the standards.

An existing solid waste management unit may become a hazardous waste management unit requiring a RCRA permit when a waste becomes newly listed or identified as hazardous. Owners and operators of facilities not previously requiring a RCRA permit who have existing units handling newly listed or identified hazardous waste can submit a part A application and obtain interim status. The air emission standards promulgated today would be implemented at these newly regulated facilities on the following schedule:

—180 days following the date the managed waste is listed or identified as hazardous, the standards become effective; facilities become subject to the subpart AA and/or BB standards.

—On the effective date of the standards, each facility that does not have the control devices required by the process and/or equipment leak standards in place must have one of the following in the facility's operating record: (1) An implementation schedule indicating when the controls will be installed, or (2) a process vent emission rate determination that documents that the emission rate limit is not exceeded (therefore, controls are not required).

—No later than 18 months following the effective date (2 years following promulgation), the controls required by the standards must be installed at all facilities.

Newly constructed TSDF are required to submit part A and part B permit applications and to receive a final permit prior to construction as required by § 270.10. Following the effective date of the standards promulgated today, a part B application for a new facility must demonstrate compliance with the standards as contained in part 264, if applicable. Therefore, all controls required by the standards would have to be in place and operating upon startup.

Similarly, new waste management units added to existing facilities would have to be equipped with the required controls prior to startup. For a new unit added to an existing permitted facility, a permit modification would be necessary. Where a new unit is added to a facility in interim status, the owner or operator must submit a revised part A application (§ 270.72(c)), including an explanation of the need for the new unit, and then receive approval from the permitting authority.

For facilities with hazardous waste management units that previously were not subject to control requirements because the wastes in the units did not contain organics in concentrations greater than the applicability criterion of 10 ppmw or 10 percent, the owner or operator would be required to comply with all subpart AA or BB requirements on the date that the facility or waste management unit becomes affected by the rules (i.e., the date the facility begins to manage wastes in the units with organic concentrations greater than 10 ppmw for subpart AA or greater than 10 percent for subpart BB) irrespective of any change in permit status that is required by the change in waste concentration. In this situation, should the facility owner or operator elect to use a control device to comply with the process vent or equipment leak provisions, the control device must be installed and operating on the date when the unit becomes subject to the rules; the 24-month extension is not applicable in this case. For the process vent emission rate limit, the situation is somewhat different. TSDF process vents associated with the distillation/separation operations specified in the rule that manage wastes with organics concentrations of 10 ppmw or greater are affected by the regulation regardless of whether the facility emissions are above or below the emission rate limit. Therefore, any change in the facility operations that results in a TSDF going above or below the emission rate limit does not cause a change in the applicability of the facility to subpart AA. The rules require that affected TSDF reduce total process vent organic emissions from all affected vents by 95 percent or reduce the facility's total process vent emissions to or below 1.4 kg/h and 2.8 Mg/yr. One of these conditions must be met at all times; the facility's emission rate determination, which documents the facility's status regarding compliance with the process vent standards, must also at all times reflect current design and operation and wastes managed in the affected units.

The permitting authority cited by section 3005 of RCRA and codified in § 270.32(b)(2) states that permits issued under this section "* * * shall contain such terms and conditions as the Administrator or State Director determines necessary to protect human health and the environment." This section, in effect, allows permit writers to require, on a case-by-case basis, emission controls that are more stringent than those specified by a standard. This omnibus authority could be used in situations where, in the permit writer's judgment, there is an unacceptably high residual risk after application of controls required by an emission standard. As has been stated, the approach that EPA is using in today's regulatory action is to proceed with promulgation of regulations to control organic emissions and to follow this with regulations that would require more stringent controls for individual hazardous constituents or would otherwise reduce risk where necessary. Until then, permit writers should use their omnibus permitting authority to require more stringent controls at facilities where a high residual risk remains after implementation of the standards for volatile organics.

## X. Administrative Requirements

### *A. Regulatory Impact Analysis*

Executive Order No. 12291 (E.O. 12291) requires each Federal agency to determine whether a regulation is a "major" rule as defined by the order and, "to the extent permitted by law," to prepare and consider a Regulatory Impact Analysis (RIA) in connection with every major rule. Major rules are defined as those likely to result in:

1. An annual cost to the economy of $100 million or more; or
2. A major increase in costs or prices for consumers or individual industries; or
3. Significant adverse effects on competition, employment, investment, productivity, innovation, or international trade.

The final rule establishes the specific emission levels and emission control programs that facilities must meet in reducing air emissions from hazardous waste management units. A complete assessment of the costs, impacts, and benefits of these rules has been conducted by EPA. This analysis indicates that the requirements of the rules for TSDF equipment leaks and process vents result in none of the economic effects set forth in section 1 of the E.O. 12291 as grounds for finding a regulation to be major. The industry-wide annualized costs of the standards are estimated to be $46 million, which is less than the $100 million established as the first criterion for a major regulation in E.O. 12291. Price increases associated with the final standards are not considered a "major increase in costs or prices" specified as the second criterion in E.O. 12291. The final standard's effect on the industry would not result in any significant adverse effects on competition, investment, productivity, employment, innovation, or the ability of U.S. firms to compete with foreign firms (the third criterion in E.O. 12291).

The final rule was submitted to the Office of Management and Budget (OMB) for review as required by E.O. 12291.

### *B. Regulatory Flexibility Act*

Under the Regulatory Flexibility Act, whenever an Agency publishes any proposed or final rule in the **Federal Register**, it must prepare a Regulatory Flexibility Analysis (RFA) that describes the impact of the rule on small entities (i.e., small businesses, organizations, and governmental jurisdictions). This analysis is not necessary, however, if the Agency's Administrator certifies that the rule will not have a significant economic impact on a substantial number of small entities. The EPA has established guidelines for determining whether an RFA is required to accompany a rulemaking package. The guidelines state that if at least 20 percent of the universe of "small entities" is affected by the rule, then an RFA is required. In addition, the EPA criteria are used to evaluate if a regulation will have a "significant impact" on small entities. If any one of the following four criteria is met, the regulation should be assumed to have a "significant impact:"

1. Annual compliance costs increase the relevant production costs for small entities by more than 5 percent.
2. The ratio of compliance costs to sales will be 10 percent higher for small entities than for large entities.
3. Capital costs of compliance will represent a significant portion of the capital available to small entities, taking into account internal cash flow plus external financing capabilities.
4. The costs of the regulation will likely result in closures of small entities.

At proposal, EPA's Administrator certified that the rule would not have a significant impact on small businesses because the only entities subject to the rule are those required to have a permit for treatment, storage, and disposal of hazardous waste. Few, if any, of these facilities are small entities. Based on comments received at proposal, EPA reviewed this conclusion in light of the revisions made to the proposed standards and closely examined the potential impacts on the industry segment comprised primarily of small commercial recyclers. As a result of the revisions made to exempt small facilities from having to install control devices, EPA again concluded that the economic impact on small businesses will be minimal and did not prepare a formal RFA in support of the rule.

Accordingly, I hereby certify that this regulation will not have a significant impact on a substantial number of small entities. Therefore, this regulation does not require an RFA.

### *C. Paperwork Reduction Act*

The information collection requirements contained in this rule have been approved by OMB under the provisions of the Paperwork Reduction Act, 44 U.S.C. 3501 et seq. and have been assigned OMB control number 2060–0195.

Public reporting burden resulting from this rulemaking is estimated to be about 9 hours per response (on average), including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Recordkeeping requirements are estimated to require 180 hours a year for each facility.

Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Chief, Information Policy Branch, PM-223, U.S. Environmental Protection Agency, 401 M Street SW., Washington, DC 20460; and to the Office of Information and Regulatory Affairs (Paperwork Reduction Project (2060-0195)), Office of Management and Budget, Washington, DC 20503, marked "Attention: Desk Officer for EPA."

*D. Supporting Documentation*

The dockets for this rulemaking (Docket No. F–86–AESP–FFFFF, which covers the development of the rules up to proposal, and Docket No. F–90–AESF–FFFFF, which covers development of the final rules from proposal to promulgation) are available for public inspection at the EPA RCRA Docket Office (OS–300) in room 2427M of the U.S. Environmental Protection Agency, 401 M Street SW., Washington, DC 20460. The docket room is open from 9 a.m. to 4 p.m., Monday through Friday, except for Federal holidays. The public must make an appointment to review docket materials and should call (202) 475–9327 for appointments. Docket A–79–27, containing support information used in developing the National Emission Standard for Hazardous Air Pollutants: Benzene Fugitive Emissions, is available for public inspection and copying between 8 a.m. and 4 p.m., Monday through Friday, at EPA's Central Docket Section, room 2903B, Waterside Mall, 401 M Street SW., Washington, DC 20460. The public may copy a maximum of 50 pages of material from any one regulatory docket at no cost. Additional copies cost $0.20/page. The docket contains a copy of all references cited in the BID for the proposed and final rules, as well as other relevant reports and correspondence.

**E. List of Subjects**

*40 CFR Part 260*

Air stripping operation, Closed-vent system, Condenser, Control device, Distillation operation, Equipment, Fractionation operation, Process vent, Solvent extraction operation, Steam stripping operation, Thin-film evaporation operation, Vapor incinerator, Vented, Incorporation by reference.

*40 CFR Part 261*

Hazardous waste, Recyclable materials, Recycling, Hazardous waste management units.

*40 CFR Parts 264 and 265*

Hazardous waste, Treatment, storage, and disposal facilities, Air emission standards for process vents, Air emission standards for equipment leaks, Incorporation by reference, Process vents, Closed-vent systems, Control devices' Pumps, Valves, Pressure relief devices, Sampling connection systems, Open-ended lines, Alternative standards, Test methods, Recordkeeping requirements, Reporting requirements.

*40 CFR Part 270*

Administrative practices and procedures, Hazardous waste permit program, Process vents, Equipment leaks, Reporting and recordkeeping requirements.

*40 CFR Part 271*

Hazardous waste, State hazardous waste programs, Process vent and equipment leak air emission standards for TSDF.

Dated June 13, 1990.

**William K. Reilly,**

*Administrator.*

For the reasons set out in the preamble, chapter I, title 40, of the Code of Federal Regulations, parts 260, 261, 264, 265, 270, and 271, are amended as follows.

## PART 260—HAZARDOUS WASTE MANAGEMENT SYSTEM: GENERAL

1. The authority citation for part 260 continues to read as follows:

**Authority:** 42 U.S.C. 6905, 6912(a), 6921 through 6927, 6930, 6934, 6935, 6937, 6938, and 6939.

2. Section 260.11 is amended by adding the following references to paragraph (a):

**§ 260.11 References.**

(a) * * *

* * * * *

"ASTM Standard Method for Analysis of Reformed Gas by Gas Chromatography," ASTM Standard D 1946–82, available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

"ASTM Standard Test Method for Heat of Combustion of Hydrocarbon Fuels by Bomb Calorimeter (High-Precision Method)," ASTM Standard D 2382–83, available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

"ASTM Standard Practices for General Techniques of Ultraviolet-Visible Quantitative Analysis," ASTM Standard E 169–87, available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

"ASTM Standard Practices for General Techniques of Infrared Quantitative Analysis," ASTM Standard E 168–88, available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

"ASTM Standard Practice for Packed Column Gas Chromatography," ASTM Standard E 260–85, available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

"ASTM Standard Test Method for Aromatics in Light Naphthas and Aviation Gasolines by Gas Chromatography," ASTM Standard D 2267–88, available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

"ASTM Standard Test Method for Vapor Pressure-Temperature Relationship and Initial Decomposition Temperature of Liquids by Isoteriscope," ASTM Standard D 2879–86, available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

"APTI Course 415: Control of Gaseous Emissions," EPA Publication EPA–450/2–81–005, December 1981, available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

* * * * *

## PART 251—IDENTIFICATION AND LISTING OF HAZARDOUS WASTE

3. The authority citation for part 261 continues to read as follows:

**Authority:** 42 U.S.C. 6905, 6912, 6921, 6922, and 6937.

### Subpart A—General

4. In § 261.6, paragraph (c)(1) is revised and paragraphs (c)(2)(iii) and (d) are added to read as follows:

**§ 261.6 Requirements for recyclable materials.**

* * * * *

(c)(1) Owners or operators of facilities that store recyclable materials before they are recycled are regulated under all applicable provisions of subparts A through L, AA, and BB of parts 264 and 265, and under parts 124, 266, 268, and 270 of this chapter and the notification requirements under section 3010 of RCRA, except as provided in paragraph (a) of this section. (The recycling process itself is exempt from regulation except as provided in § 261.6(d).)

(2) * * *

(iii) Section 261.6(d) of this chapter.

(d) Owners or operators of facilities subject to RCRA permitting requirements with hazardous waste management units that recycle hazardous wastes are subject to the requirements of subparts AA and BB of part 264 or 265 of this chapter.

## PART 264—STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

5. The authority citation for part 264 continues to read as follows:

Authority: 42 U.S.C. 6905, 6912(a), 6924, and 6925.

## Subpart B—General Facility Standards

6. Section 264.13 is amended by revising paragraph (b)(6) to read as follows:

### § 264.13 General waste analysis.

* * * * *

(b) * * *

(6) Where applicable, the methods that will be used to meet the additional waste analysis requirements for specific waste management methods as specified in §§ 264.17, 264.314, 264.341, 264.1034(d), 264.1063(d), and 268.7 of this chapter.

* * * * *

7. Section 264.15 is amended by revising the last sentence of paragraph (b)(4) to read as follows:

### § 264.15 General inspection requirements.

* * * * *

(b) * * *

(4) * * * At a minimum, the inspection schedule must include the terms and frequencies called for in §§ 264.174, 264.194, 264.226, 264.253, 264.254, 264.303, 264.347, 264.602, 264.1033, 264.1052, 264.1053, and 264.1058, where applicable.

* * * * *

## Subpart E—Manifest System, Recordkeeping, and Reporting

8. Section 264.73 is amended by revising paragraphs (b)(3) and (b)(6) to read as follows:

### § 264.73 Operation record.

* * * * *

(b) * * *

(3) Records and results of waste analyses performed as specified in §§ 264.13, 264.17, 264.314, 264.341, 264.1034, 264.1063, 268.4(a), and 268.7 of this chapter.

* * * * *

(6) Monitoring, testing or analytical data, and corrective action where required by subpart F and §§ 264.226, 264.253, 264.254, 264.276, 264.278, 264.280, 264.303, 264.309, 264.347, 264.602, 264.1034(c)–264.1034(f), 264.1035, 264.1063(d)–264.1063(i), and 264.1064.

* * * * *

9. Section 264.77 is amended by revising paragraph (c) to read as follows:

### § 264.77 Additional reports.

* * * * *

(c) As otherwise required by subparts F, K through N, AA, and BB.

10. 40 CFR part 264 is amended by adding subpart AA to read as follows:

**Subpart AA—Air Emission Standards for Process Vents**

264.1030 Applicability.
264.1031 Definitions.
264.1032 Standards: Process vents.
264.1033 Standards: Closed-vent systems and control devices.
264.1034 Test methods and procedures.
264.1035 Recordkeeping requirements.
264.1036 Reporting requirements.
264.1037–264.1049 [Reserved]

## Subpart AA—Air Emission Standards for Process Vents

### § 264.1030 Applicability.

(a) The regulations in this subpart apply to owners and operators of facilities that treat, store, or dispose of hazardous wastes (except as provided in § 2641).

(b) Except for §§ 264.1034(d) and 264.1035(e), this subpart applies to process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations that manage hazardous wastes with organic concentrations of at least 10-ppmw, if these operations are conducted in:

(1) Units that are subject to the permitting requirements of part 270, or

(2) Hazardous waste recycling units that are located on hazardous waste management facilities otherwise subject to the permitting requirements of part 270.

(c) If the owner or operator of process vents subject to the requirements of §§ 264.1032 through 264.1036 has received a permit under section 3005 of RCRA prior to December 21, 1990 the requirements of §§ 264.1032 through 264.1036 must be incorporated when the permit is reissued under § 124.15 or reviewed under § 270.50.

[Note: The requirements of §§ 264.1032 through 264.1036 apply to process vents on hazardous waste recycling units previously exempt under paragraph 261.6(c)(1). Other exemptions under §§ 261.4, 262.34, and 264.1(g) are not affected by these requirements.]

### § 264.1031 Definitions.

As used in this subpart, all terms not defined herein shall have the meaning given them in the Act and parts 260–266.

*Air stripping operation* is a desorption operation employed to transfer one or more volatile components from a liquid mixture into a gas (air) either with or without the application of heat to the liquid. Packed towers, spray towers, and bubble-cap, sieve, or valve-type plate towers are among the process configurations used for contacting the air and a liquid.

*Bottoms receiver* means a container or tank used to receive and collect the heavier bottoms fractions of the distillation feed stream that remain in the liquid phase.

*Closed-vent system* means a system that is not open to the atmosphere and that is composed of piping, connections, and, if necessary, flow-inducing devices that transport gas or vapor from a piece or pieces of equipment to a control device.

*Condenser* means a heat-transfer device that reduces a thermodynamic fluid from its vapor phase to its liquid phase.

*Connector* means flanged, screwed, welded, or other joined fittings used to connect two pipelines or a pipeline and a piece of equipment. For the purposes of reporting and recordkeeping, connector means flanged fittings that are not covered by insulation or other materials that prevent location of the fittings.

*Continuous recorder* means a data-recording device recording an instantaneous data value at least once every 15 minutes.

*Control device* means an enclosed combustion device, vapor recovery system, or flare. Any device the primary function of which is the recovery or capture of solvents or other organics for use, reuse, or sale (e.g., a primary condenser on a solvent recovery unit) is not a control device.

*Control device shutdown* means the cessation of operation of a control device for any purpose.

*Distillate receiver* means a container or tank used to receive and collect liquid material (condensed) from the overhead condenser of a distillation unit and from which the condensed liquid is pumped to larger storage tanks or other process units.

*Distillation operation* means an operation, either batch or continuous, separating one or more feed stream(s) into two or more exit streams, each exit stream having component concentrations different from those in the feed stream(s). The separation is achieved by the redistribution of the components between the liquid and vapor phase as they approach equilibrium within the distillation unit.

*Double block and bleed system* means two block valves connected in series with a bleed valve or line that can vent the line between the two block valves.

*Equipment* means each valve, pump, compressor, pressure relief device, sampling connection system, open-ended valve or line, or flange, and any control devices or systems required by this subpart.

*Flame zone* means the portion of the combustion chamber in a boiler occupied by the flame envelope.

*Flow indicator* means a device that indicates whether gas flow is present in a vent stream.

*First attempt at repair* means to take rapid action for the purpose of stopping or reducing leakage of organic material to the atmosphere using best practices.

*Fractionation operation* means a distillation operation or method used to separate a mixture of several volatile components of different boiling points in successive stages, each stage removing from the mixture some proportion of one of the components.

*Hazardous waste management unit shutdown* means a work practice or operational procedure that stops operation of a hazardous waste management unit or part of a hazardous waste management unit. An unscheduled work practice or operational procedure that stops operation of a hazardous waste management unit or part of a hazardous waste management unit for less than 24 hours is not a hazardous waste management unit shutdown. The use of spare equipment and technically feasible bypassing of equipment without stopping operation are not hazardous waste management unit shutdowns.

*Hot well* means a container for collecting condensate as in a steam condenser serving a vacuum-jet or steam-jet ejector.

*In gas/vapor service* means that the piece of equipment contains or contacts a hazardous waste stream that is in the gaseous state at operating conditions.

*In heavy liquid service* means that the piece of equipment is not in gas/vapor service or in light liquid service.

*In light liquid service* means that the piece of equipment contains or contacts a waste stream where the vapor pressure of one or more of the components in the stream is greater than 0.3 kilopascals (kPa) at 20 °C, the total concentration of the pure components having a vapor pressure greater than 0.3 kPa at 20 °C is equal to or greater than 20 percent by weight, and the fluid is a liquid at operating conditions.

*In situ sampling systems* means nonextractive samplers or in-line samplers.

*In vacuum service* means that equipment is operating at an internal pressure that is at least 5 kPa below ambient pressure.

*Malfunction* means any sudden failure of a control device or a hazardous waste management unit or failure of a hazardous waste management unit to operate in a normal or usual manner, so that organic emissions are increased.

*Open-ended valve or line* means any valve, except pressure relief valves, having one side of the valve seat in contact with process fluid and one side open to the atmosphere, either directly or through open piping.

*Pressure release* means the emission of materials resulting from the system pressure being greater than the set pressure of the pressure relief device.

*Process heater* means a device that transfers heat liberated by burning fuel to fluids contained in tubes, including all fluids except water that are heated to produce steam.

*Process vent* means any open-ended pipe or stack that is vented to the atmosphere either directly, through a vacuum-producing system, or through a tank (e.g., distillate receiver, condenser, bottoms receiver, surge control tank, separator tank, or hot well) associated with hazardous waste distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations.

*Repaired* means that equipment is adjusted, or otherwise altered, to eliminate a leak.

*Sensor* means a device that measures a physical quantity or the change in a physical quantity, such as temperature, pressure, flow rate, pH, or liquid level.

*Separator tank* means a device used for separation of two immiscible liquids.

*Solvent extraction operation* means an operation or method of separation in which a solid or solution is contacted with a liquid solvent (the two being mutually insoluble) to preferentially dissolve and transfer one or more components into the solvent.

*Startup* means the setting in operation of a hazardous waste management unit or control device for any purpose.

*Steam stripping operation* means a distillation operation in which vaporization of the volatile constituents of a liquid mixture takes place by the introduction of steam directly into the charge.

*Surge control tank* means a large-sized pipe or storage reservoir sufficient to contain the surging liquid discharge of the process tank to which it is connected.

*Thin-film evaporation operation* means a distillation operation that employs a heating surface consisting of a large diameter tube that may be either straight or tapered, horizontal or vertical. Liquid is spread on the tube wall by a rotating assembly of blades that maintain a close clearance from the wall or actually ride on the film of liquid on the wall.

*Vapor incinerator* means any enclosed combustion device that is used for destroying organic compounds and does not extract energy in the form of steam or process heat.

*Vented* means discharged through an opening, typically an open-ended pipe or stack, allowing the passage of a stream of liquids, gases, or fumes into the atmosphere. The passage of liquids, gases, or fumes is caused by mechanical means such as compressors or vacuum-producing systems or by process-related means such as evaporation produced by heating and not caused by tank loading and unloading (working losses) or by natural means such as diurnal temperature changes.

**§ 264.1032 Standards: Process vents.**

(a) The owner or operator of a facility with process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations managing hazardous wastes with organic concentrations of at least 10 ppmw shall either:

(1) Reduce total organic emissions from all affected process vents at the facility below 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 tons/yr), or

(2) Reduce, by use of a control device, total organic emissions from all affected process vents at the facility by 95 weight percent.

(b) If the owner or operator installs a closed-vent system and control device to comply with the provisions of paragraph (a) of this section the closed-vent system and control device must meet the requirements of § 264.1033.

(c) Determinations of vent emissions and emission reductions or total organic compound concentrations achieved by add-on control devices may be based on engineering calculations or performance tests. If performance tests are used to determine vent emissions, emission reductions, or total organic compound concentrations achieved by add-on control devices, the performance tests must conform with the requirements of § 264.1034(c).

(d) When an owner or operator and the Regional Administrator do not agree on determinations of vent emissions and/or emission reductions or total organic compound concentrations achieved by add-on control devices based on engineering calculations, the procedures in § 264.1034(c) shall be used to resolve the disagreement.

**§ 264.1033 Standards: Closed-vent systems and control devices.**

(a)(1) Owners or operators of closed-vent systems and control devices used to comply with provisions of this part shall comply with the provisions of this section.

(2) The owner or operator of an existing facility who cannot install a closed-vent system and control device to comply with the provisions of this subpart on the effective date that the facility becomes subject to the provisions of this subpart must prepare an implementation schedule that includes dates by which the closed-vent system and control device will be installed and in operation. The controls must be installed as soon as possible, but the implementation schedule may allow up to 18 months after the effective date that the facility becomes subject to this subpart for installation and startup. All units that begin operation after December 21, 1990, must comply with the rules immediately (i.e., must have control devices installed and operating on startup of the affected unit); the 2-year implementation schedule does not apply to these units.

(b) A control device involving vapor recovery (e.g., a condenser or adsorber) shall be designed and operated to recover the organic vapors vented to it with an efficiency of 95 weight percent or greater unless the total organic emission limits of § 264.1032(a)(1) for all affected process vents can be attained at an efficiency less than 95 weight percent.

(c) An enclosed combustion device (e.g., a vapor incinerator, boiler, or process heater) shall be designed and operated to reduce the organic emissions vented to it by 95 weight percent or greater; to achieve a total organic compound concentration of 20 ppmv, expressed as the sum of the actual compounds, not carbon equivalents, on a dry basis corrected to 3 percent oxygen; or to provide a minimum residence time of 0.50 seconds at a minimum temperature of 760 °C. If a boiler or process heater is used as the control device, then the vent stream shall be introduced into the flame zone of the boiler or process heater.

(d)(1) A flare shall be designed for and operated with no visible emissions as determined by the methods specified in paragraph (e)(1) of this section, except for periods not to exceed a total of 5 minutes during any 2 consecutive hours.

(2) A flare shall be operated with a flame present at all times, as determined by the methods specified in paragraph (f)(2)(iii) of this section.

(3) A flare shall be used only if the net heating value of the gas being combusted is 11.2 MJ/scm (300 Btu/scf) or greater if the flare is steam-assisted or air-assisted; or if the net heating value of the gas being combusted is 7.45 MJ/scm (200 Btu/scf) or greater if the flare is nonassisted. The net heating value of the gas being combusted shall be determined by the methods specified in paragraph (e)(2) of this section.

(4)(i) A steam-assisted or nonassisted flare shall be designed for and operated with an exit velocity, as determined by the methods specified in paragraph (e)(3) of this section, less than 18.3 m/s (60 ft/s), except as provided in paragraphs (d)(4) (ii) and (iii) of this section.

(ii) A steam-assisted or nonassisted flare designed for and operated with an exit velocity, as determined by the methods specified in paragraph (e)(3) of this section, equal to or greater than 18.3 m/s (60 ft/s) but less than 122 m/s (400 ft/s) is allowed if the net heating value of the gas being combusted is greater than 37.3 MJ/scm (1,000 Btu/scf).

(iii) A steam-assisted or nonassisted flare designed for and operated with an exit velocity, as determined by the methods specified in paragraph (e)(3) of this section, less than the velocity, $V_{max}$, as determined by the method specified in paragraph (e)(4) of this section and less than 122 m/s (400 ft/s) is allowed.

(5) An air-assisted flare shall be designed and operated with an exit velocity less than the velocity, $V_{max}$, as determined by the method specified in paragraph (e)(5) of this section.

(6) A flare used to comply with this section shall be steam-assisted, air-assisted, or nonassisted.

(e)(1) Reference Method 22 in 40 CFR part 60 shall be used to determine the compliance of a flare with the visible emission provisions of this subpart. The observation period is 2 hours and shall be used according to Method 22.

(2) The net heating value of the gas being combusted in a flare shall be calculated using the following equation:

$$H_T = K \left[ \sum_{i=1}^{n} C_i H_i \right]$$

where:

$H_T$ = Net heating value of the sample, MJ/scm; where the net enthalpy per mole of offgas is based on combustion at 25 °C and 760 mm Hg, but the standard temperature for determining the volume corresponding to 1 mol is 20 °C;

K = Constant, $1.74 \times 10^{-7}$ (1/ppm) (g mol/scm) (MJ/kcal) where standard temperature for (g mol/scm) is 20 °C;

$C_i$ = Concentration of sample component i in ppm on a wet basis, as measured for organics by Reference Method 18 in 40 CFR part 60 and measured for hydrogen and carbon monoxide by ASTM D 1946-82 (incorporated by reference as specified in § 260.11); and

$H_i$ = Net heat of combustion of sample component i, kcal/9 mol at 25 °C and 760 mm Hg. The heats of combustion may be determined using ASTM D 2382-83 (incorporated by reference as specified in § 260.11) if published values are not available or cannot be calculated.

(3) The actual exit velocity of a flare shall be determined by dividing the volumetric flow rate (in units of standard temperature and pressure), as determined by Reference Methods 2, 2A, 2C, or 2D in 40 CFR part 60 as appropriate, by the unobstructed (free) cross-sectional area of the flare tip.

(4) The maximum allowed velocity in m/s, $V_{max}$, for a flare complying with paragraph (d)(4)(iii) of this section shall be determined by the following equation:

$$\text{Log}_{10}(V_{max}) = (H_T + 28.8)/31.7$$

where:

28.8 = Constant,

31.7 = Constant,

$H_T$ = The net heating value as determined in paragraph (e)(2) of this section.

(5) The maximum allowed velocity in m/s, $V_{max}$, for an air-assisted flare shall be determined by the following equation:

$$V_{max} = 8.706 + 0.7084 (H_T)$$

where:

8.706 = Constant,

0.7084 = Constant,

$H_T$ = The net heating value as determined in paragraph (e)(2) of this section.

(f) The owner or operator shall monitor and inspect each control device required to comply with this section to ensure proper operation and maintenance of the control device by implementing the following requirements:

(1) Install, calibrate, maintain, and operate according to the manufacturer's specifications a flow indicator that provides a record of vent stream flow from each affected process vent to the control device at least once every hour. The flow indicator sensor shall be installed in the vent stream at the nearest feasible point to the control

device inlet but before the point at which the vent streams are combined.

(2) Install, calibrate, maintain, and operate according to the manufacturer's specifications a device to continuously monitor control device operation as specified below:

(i) For a thermal vapor incinerator, a temperature monitoring device equipped with a continuous recorder. The device shall have an accuracy of ±1 percent of the temperature being monitored in °C or ±0.5 °C, whichever is greater. The temperature sensor shall be installed at a location in the combustion chamber downstream of the combustion zone.

(ii) For a catalytic vapor incinerator, a temperature monitoring device equipped with a continuous recorder. The device shall be capable of monitoring temperature at two locations and have an accuracy of ±1 percent of the temperature being monitored in °C or ±0.5 °C, whichever is greater. One temperature sensor shall be installed in the vent stream at the nearest feasible point to the catalyst bed inlet and a second temperature sensor shall be installed in the vent stream at the nearest feasible point to the catalyst bed outlet.

(iii) For a flare, a heat sensing monitoring device equipped with a continuous recorder that indicates the continuous ignition of the pilot flame.

(iv) For a boiler or process heater having a design heat input capacity less than 44 MW, a temperature monitoring device equipped with a continuous recorder. The device shall have an accuracy of ±1 percent of the temperature being monitored in °C or ±0.5 °C, whichever is greater. The temperature sensor shall be installed at a location in the furnace downstream of the combustion zone.

(v) For a boiler or process heater having a design heat input capacity greater than or equal to 44 MW, a monitoring device equipped with a continuous recorder to measure a parameter(s) that indicates good combustion operating practices are being used.

(vi) For a condenser, either:

(A) A monitoring device equipped with a continuous recorder to measure the concentration level of the organic compounds in the exhaust vent stream from the condenser, or

(B) A temperature monitoring device equipped with a continuous recorder. The device shall be capable of monitoring temperature at two locations and have an accuracy of ±1 percent of the temperature being monitored in °C or ±0.5 °C, whichever is greater. One temperature sensor shall be installed at a location in the exhaust vent stream from the condenser, and a second temperature sensor shall be installed at a location in the coolant fluid exiting the condenser.

(vii) For a carbon adsorption system that regenerates the carbon bed directly in the control device such as a fixed-bed carbon adsorber, either:

(A) A monitoring device equipped with a continuous recorder to measure the concentration level of the organic compounds in the exhaust vent stream from the carbon bed, or

(B) A monitoring device equipped with a continuous recorder to measure a parameter that indicates the carbon bed is regenerated on a regular, predetermined time cycle.

(3) Inspect the readings from each monitoring device required by paragraphs (1) and (2) of this section at least once each operating day to check control device operation and, if necessary, immediately implement the corrective measures necessary to ensure the control device operates in compliance with the requirements of this section.

(g) An owner or operator using a carbon adsorption system such as a fixed-bed carbon adsorber that regenerates the carbon bed directly onsite in the control device shall replace the existing carbon in the control device with fresh carbon at a regular, predetermined time interval that is no longer than the carbon service life established as a requirement of § 264.1035(b)(4)(iii)(F).

(h) An owner or operator using a carbon adsorption system such as a carbon canister that does not regenerate the carbon bed directly onsite in the control device shall replace the existing carbon in the control device with fresh carbon on a regular basis by using one of the following procedures:

(1) Monitor the concentration level of the organic compounds in the exhaust vent stream from the carbon adsorption system on a regular schedule, and replace the existing carbon with fresh carbon immediately when carbon breakthrough is indicated. The monitoring frequency shall be daily or at an interval no greater than 20 percent of the time required to consume the total carbon working capacity established as a requirement of § 264.1035(b)(4)(iii)(G), whichever is longer.

(2) Replace the existing carbon with fresh carbon at a regular, predetermined time interval that is less than the design carbon replacement interval established as a requirement of § 264.1035(b)(4)(iii)(G).

(i) An alternative operational or process parameter may be monitored if it can be demonstrated that another parameter will ensure that the control device is operated in conformance with these standards and the control device's design specifications.

(j) An owner or operator of an affected facility seeking to comply with the provisions of this part by using a control device other than a thermal vapor incinerator, catalytic vapor incinerator, flare, boiler, process heater, condenser, or carbon adsorption system is required to develop documentation including sufficient information to describe the control device operation and identify the process parameter or parameters that indicate proper operation and maintenance of the control device.

(k)(1) Closed-vent systems shall be designed for and operated with no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background and by visual inspections, as determined by the methods specified as § 264.1034(b).

(2) Closed-vent systems shall be monitored to determine compliance with this section during the initial leak detection monitoring, which shall be conducted by the date that the facility becomes subject to the provisions of this section, annually, and at other times as requested by the Regional Administrator.

(3) Detectable emissions, as indicated by an instrument reading greater than 500 ppm and visual inspections, shall be controlled as soon as practicable, but not later than 15 calendar days after the emission is detected.

(4) A first attempt at repair shall be made no later than 5 calendar days after the emission is detected.

(l) Closed-vent systems and control devices used to comply with provisions of this subpart shall be operated at all times when emissions may be vented to them.

### § 264.1034 Test methods and procedures.

(a) Each owner or operator subject to the provisions of this subpart shall comply with the test methods and procedures requirements provided in this section.

(b) When a closed-vent system is tested for compliance with no detectable emissions, as required in § 264.1033(k), the test shall comply with the following requirements:

(1) Monitoring shall comply with Reference Method 21 in 40 CFR part 60.

(2) The detection instrument shall meet the performance criteria of Reference Method 21.

(3) The instrument shall be calibrated before use on each day of its use by the

procedures specified in Reference Method 21.

(4) Calibration gases shall be:

(i) Zero air (less than 10 ppm of hydrocarbon in air).

(ii) A mixture of methane or n-hexane and air at a concentration of approximately, but less than, 10,000 ppm methane or n-hexane.

(5) The background level shall be determined as set forth in Reference Method 21.

(6) The instrument probe shall be traversed around all potential leak interfaces as close to the interface as possible as described in Reference Method 21.

(7) The arithmetic difference between the maximum concentration indicated by the instrument and the background level is compared with 500 ppm for determining compliance.

(c) Performance tests to determine compliance with § 264.1032(a) and with the total organic compound concentration limit of § 264.1033(c) shall comply with the following:

(1) Performance tests to determine total organic compound concentrations and mass flow rates entering and exiting control devices shall be conducted and data reduced in accordance with the following reference methods and calculation procedures:

(i) Method 2 in 40 CFR part 60 for velocity and volumetric flow rate.

(ii) Method 18 in 40 CFR part 60 for organic content.

(iii) Each performance test shall consist of three separate runs; each run conducted for at least 1 hour under the conditions that exist when the hazardous waste management unit is operating at the highest load or capacity level reasonably expected to occur. For the purpose of determining total organic compound concentrations and mass flow rates, the average of results of all runs shall apply. The average shall be computed on a time-weighted basis.

(iv) Total organic mass flow rates shall be determined by the following equation:

$$E_h = Q_{2sd}\left\{\sum_{i=1}^{n} C_i MW_i\right\}[0.0416][10^{-6}]$$

where:

$E_h$ = Total organic mass flow rate, kg/h;

$Q_{2sd}$ = Volumetric flow rate of gases entering or exiting control device, as determined by Method 2, dscm/h;

n = Number of organic compounds in the vent gas;

$C_i$ = Organic concentration in ppm, dry basis, of compound i in the vent gas, as determined by Method 18;

$MW_i$ = Molecular weight of organic compound i in the vent gas, kg/kg-mol;

0.0416 = Conversion factor for molar volume, kg-mol/m³ (@ 293 K and 760 mm Hg);

$10^{-6}$ = Conversion from ppm, ppm$^{-1}$.

(v) The annual total organic emission rate shall be determined by the following equation:

$E_A = (E_h)(H)$

where:

$E_A$ = Total organic mass emission rate, kg/y;

$E_h$ = Total organic mass flow rate for the process vent, kg/h;

H = Total annual hours of operations for the affected unit, h.

(vi) Total organic emissions from all affected process vents at the facility shall be determined by summing the hourly total organic mass emission rates ($E_h$ as determined in paragraph (c)(1)(iv) of this section) and by summing the annual total organic mass emission rates ($E_A$, as determined in paragraph (c)(1)(v) of this section) for all affected process vents at the facility.

(2) The owner or operator shall record such process information as may be necessary to determine the conditions of the performance tests. Operations during periods of startup, shutdown, and malfunction shall not constitute representative conditions for the purpose of a performance test.

(3) The owner or operator of an affected facility shall provide, or cause to be provided, performance testing facilities as follows:

(i) Sampling ports adequate for the test methods specified in paragraph (c)(1) of this section.

(ii) Safe sampling platform(s).

(iii) Safe access to sampling platform(s).

(iv) Utilities for sampling and testing equipment.

(4) For the purpose of making compliance determinations, the time-weighted average of the results of the three runs shall apply. In the event that a sample is accidentally lost or conditions occur in which one of the three runs must be discontinued because of forced shutdown, failure of an irreplaceable portion of the sample train, extreme meteorological conditions, or other circumstances beyond the owner or operator's control, compliance may, upon the Regional Administrator's approval, be determined using the average of the results of the two other runs.

(d) To show that a process vent associated with a hazardous waste distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operation is not subject to the requirements of this subpart, the owner or operator must make an initial determination that the time-weighted, annual average total organic concentration of the waste managed by the waste management unit is less than 10 ppmw using one of the following two methods:

(1) Direct measurement of the organic concentration of the waste using the following procedures:

(i) The owner or operator must take a minimum of four grab samples of waste for each waste stream managed in the affected unit under process conditions expected to cause the maximum waste organic concentration.

(ii) For waste generated onsite, the grab samples must be collected at a point before the waste is exposed to the atmosphere such as in an enclosed pipe or other closed system that is used to transfer the waste after generation to the first affected distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operation. For waste generated offsite, the grab samples must be collected at the inlet to the first waste management unit that receives the waste provided the waste has been transferred to the facility in a closed system such as a tank truck and the waste is not diluted or mixed with other waste.

(iii) Each sample shall be analyzed and the total organic concentration of the sample shall be computed using Method 9060 or 8240 of SW–846 (incorporated by reference under § 260.11).

(iv) The arithmetic mean of the results of the analyses of the four samples shall apply for each waste stream managed in the unit in determining the time-weighted, annual average total organic concentration of the waste. The time-weighted average is to be calculated using the annual quantity of each waste stream processed and the mean organic concentration of each waste stream managed in the unit.

(2) Using knowledge of the waste to determine that its total organic concentration is less than 10 ppmw. Documentation of the waste determination is required. Examples of documentation that shall be used to support a determination under this provision include production process information documenting that no organic compounds are used, information that the waste is generated by a process that is identical to a process at the same or another facility that has previously been demonstrated by direct measurement to generate a waste stream having a total organic content less than 10 ppmw, or prior speciation analysis results on the same waste stream where it can also be documented that no process changes have occurred since that analysis that could affect the waste total organic concentration.

(e) The determination that distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations manage hazardous wastes with time-weighted, annual average total organic concentrations less than 10 ppmw shall be made as follows:

(1) By the effective date that the facility becomes subject to the provisions of this subpart or by the date when the waste is first managed in a waste management unit, whichever is later, and

(2) For continuously generated waste, annually, or

(3) Whenever there is a change in the waste being managed or a change in the process that generates or treats the waste.

(f) When an owner or operator and the Regional Administrator do not agree on whether a distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operation manages a hazardous waste with organic concentrations of at least 10 ppmw based on knowledge of the waste, the procedures in Method 8240 may be used to resolve the dispute.

### § 264.1035 Recordkeeping requirements.

(a)(1) Each owner or operator subject to the provisions of this subpart shall comply with the recordkeeping requirements of this section.

(2) An owner or operator of more than one hazardous waste management unit subject to the provisions of this subpart may comply with the recordkeeping requirements for these hazardous waste management units in one recordkeeping system if the system identifies each record by each hazardous waste management unit.

(b) Owners and operators must record the following information in the facility operating record:

(1) For facilities that comply with the provisions of § 264.1033(a)(2), an implementation schedule that includes dates by which the closed-vent system and control device will be installed and in operation. The schedule must also include a rationale of why the installation cannot be completed at an earlier date. The implementation schedule must be in the facility operating record by the effective date that the facility becomes subject to the provisions of this subpart.

(2) Up-to-date documentation of compliance with the process vent standards in § 264.1032, including:

(i) Information and data identifying all affected process vents, annual throughput and operating hours of each affected unit, estimated emission rates for each affected vent and for the overall facility (i.e., the total emissions for all affected vents at the facility), and the approximate location within the facility of each affected unit (e.g., identify the hazardous waste management units on a facility plot plan).

(ii) Information and data supporting determinations of vent emissions and emission reductions achieved by add-on control devices based on engineering calculations or source tests. For the purpose of determining compliance, determinations of vent emissions and emission reductions must be made using operating parameter values (e.g., temperatures, flow rates, or vent stream organic compounds and concentrations) that represent the conditions that result in maximum organic emissions, such as when the waste management unit is operating at the highest load or capacity level reasonably expected to occur. If the owner or operator takes any action (e.g., managing a waste of different composition or increasing operating hours of affected waste management units) that would result in an increase in total organic emissions from affected process vents at the facility, then a new determination is required.

(3) Where an owner or operator chooses to use test data to determine the organic removal efficiency or total organic compound concentration achieved by the control device, a performance test plan. The test plan must include:

(i) A description of how it is determined that the planned test is going to be conducted when the hazardous waste management unit is operating at the highest load or capacity level reasonably expected to occur. This shall include the estimated or design flow rate and organic content of each vent stream and define the acceptable operating ranges of key process and control device parameters during the test program.

(ii) A detailed engineering description of the closed-vent system and control device including:

(A) Manufacturer's name and model number of control device.

(B) Type of control device.

(C) Dimensions of the control device.

(D) Capacity.

(E) Construction materials.

(iii) A detailed description of sampling and monitoring procedures, including sampling and monitoring locations in the system, the equipment to be used, sampling and monitoring frequency, and planned analytical procedures for sample analysis.

(4) Documentation of compliance with § 264.1033 shall include the following information:

(i) A list of all information references and sources used in preparing the documentation.

(ii) Records including the dates of each compliance test required by § 264.1033(k).

(iii) If engineering calculations are used, a design analysis, specifications, drawings, schematics, and piping and instrumentation diagrams based on the appropriate sections of "APTI Course 415: Control of Gaseous Emissions" (incorporated by reference as specified in § 260.11) or other engineering texts acceptable to the Regional Administrator that present basic control device design information. Documentation provided by the control device manufacturer or vendor that describes the control device design in accordance with paragraphs (b)(4)(iii)(A) through (b)(4)(iii)(G) of this section may be used to comply with this requirement. The design analysis shall address the vent stream characteristics and control device operation parameters as specified below.

(A) For a thermal vapor incinerator, the design analysis shall consider the vent stream composition, constituent concentrations, and flow rate. The design analysis shall also establish the design minimum and average temperature in the combustion zone and the combustion zone residence time.

(B) For a catalytic vapor incinerator, the design analysis shall consider the vent stream composition, constituent concentrations, and flow rate. The design analysis shall also establish the design minimum and average temperatures across the catalyst bed inlet and outlet.

(C) For a boiler or process heater, the design analysis shall consider the vent stream composition, constituent concentrations, and flow rate. The design analysis shall also establish the design minimum and average flame zone temperatures, combustion zone residence time, and description of method and location where the vent stream is introduced into the combustion zone.

(D) For a flare, the design analysis shall consider the vent stream composition, constituent concentrations, and flow rate. The design analysis shall also consider the requirements specified in § 264.1033(d).

(E) For a condenser, the design analysis shall consider the vent stream composition, constituent concentrations, flow rate, relative humidity, and temperature. The design analysis shall also establish the design outlet organic compound concentration level, design average temperature of the condenser exhaust vent stream, and design average temperatures of the coolant fluid at the condenser inlet and outlet.

(F) For a carbon adsorption system such as a fixed-bed adsorber that regenerates the carbon bed directly onsite in the control device, the design analysis shall consider the vent stream composition, constituent concentrations, flow rate, relative humidity, and temperature. The design analysis shall also establish the design exhaust vent stream organic compound concentration level, number and capacity of carbon beds, type and working capacity of activated carbon used for carbon beds, design total steam flow over the period of each complete carbon bed regeneration cycle, duration of the carbon bed steaming and cooling/drying cycles, design carbon bed temperature after regeneration, design carbon bed regeneration time, and design service life of carbon.

(G) For a carbon adsorption system such as a carbon canister that does not regenerate the carbon bed directly onsite in the control device, the design analysis shall consider the vent stream composition, constituent concentrations, flow rate, relative humidity, and temperature. The design analysis shall also establish the design outlet organic concentration level, capacity of carbon bed, type and working capacity of activated carbon used for carbon bed, and design carbon replacement interval based on the total carbon working capacity of the control device and source operating schedule.

(iv) A statement signed and dated by the owner or operator certifying that the operating parameters used in the design analysis reasonably represent the conditions that exist when the hazardous waste management unit is or would be operating at the highest load or capacity level reasonably expected to occur.

(v) A statement signed and dated by the owner or operator certifying that the control device is designed to operate at an efficiency of 95 percent or greater unless the total organic concentration limit of § 264.1032(a) is achieved at an efficiency less than 95 weight percent or the total organic emission limits of § 264.1032(a) for affected process vents at the facility can be attained by a control device involving vapor recovery at an efficiency less than 95 weight percent. A statement provided by the control device manufacturer or vendor certifying that the control equipment meets the design specifications may be used to comply with this requirement.

(vi) If performance tests are used to demonstrate compliance, all test results.

(c) Design documentation and monitoring, operating, and inspection information for each closed-vent system and control device required to comply with the provisions of this part shall be recorded and kept up-to-date in the facility operating record. The information shall include:

(1) Description and date of each modification that is made to the closed-vent system or control device design.

(2) Identification of operating parameter, description of monitoring device, and diagram of monitoring sensor location or locations used to comply with § 264.1033 (f)(1) and (f)(2).

(3) Monitoring, operating, and inspection information required by paragraphs (f) through (k) of § 264.1033.

(4) Date, time, and duration of each period that occurs while the control device is operating when any monitored parameter exceeds the value established in the control device design analysis as specified below:

(i) For a thermal vapor incinerator designed to operate with a minimum residence time of 0.50 second at a minimum temperature of 760 °C, period when the combustion temperature is below 760 °C.

(ii) For a thermal vapor incinerator designed to operate with an organic emission reduction efficiency of 95 weight percent or greater period when the combustion zone temperature is more than 28 °C below the design average combustion zone temperature established as a requirement of paragraph (b)(4)(iii)(A) of this section.

(iii) For a catalytic vapor incinerator, period when:

(A) Temperature of the vent stream at the catalyst bed inlet is more than 28 °C below the average temperature of the inlet vent stream established as a requirement of paragraph (b)(4)(iii)(B) of this section, or

(B) Temperature difference across the catalyst bed is less than 80 percent of the design average temperature difference established as a requirement of paragraph (b)(4)(iii)(B) of this section.

(iv) For a boiler or process heater, period when:

(A) Flame zone temperature is more than 28 °C below the design average flame zone temperature established as a requirement of paragraph (b)(4)(iii)(C) of this section, or

(B) Position changes where the vent stream is introduced to the combustion zone from the location established as a requirement of paragraph (b)(4)(iii)(C) of this section.

(v) For a flare, period when the pilot flame is not ignited.

(vi) For a condenser that complies with § 264.1033(f)(2)(vi)(A), period when the organic compound concentration level or readings of organic compounds in the exhaust vent stream from the condenser are more than 20 percent greater than the design outlet organic compound concentration level established as a requirement of paragraph (b)(4)(iii)(E) of this section.

(vii) For a condenser that complies with § 264.1033(f)(2)(vi)(B), period when:

(A) Temperature of the exhaust vent stream from the condenser is more than 6 °C above the design average exhaust vent stream temperature established as a requirement of paragraph (b)(4)(iii)(E) of this section; or

(B) Temperature of the coolant fluid exiting the condenser is more than 6 °C above the design average coolant fluid temperature at the condenser outlet established as a requirement of paragraph (b)(4)(iii)(E) of this section.

(viii) For a carbon adsorption system such as a fixed-bed carbon adsorber that regenerates the carbon bed directly onsite in the control device and complies with § 264.1033(f)(2)(vii)(A), period when the organic compound concentration level or readings of organic compounds in the exhaust vent stream from the carbon bed are more than 20 percent greater than the design exhaust vent stream organic compound concentration level established as a requirement of paragraph (b)(4)(iii)(F) of this section.

(ix) For a carbon adsorption system such as a fixed-bed carbon adsorber that regenerates the carbon bed directly onsite in the control device and complies with § 264.1033(f)(2)(vii)(B), period when the vent stream continues to flow through the control device beyond the predetermined carbon bed regeneration time established as a requirement of paragraph (b)(4)(iii)(F) of this section.

(5) Explanation for each period recorded under paragraph (4) of the cause for control device operating parameter exceeding the design value and the measures implemented to correct the control device operation.

(6) For a carbon adsorption system operated subject to requirements specified in § 264.1033(g) or § 264.1033(h)(2), date when existing carbon in the control device is replaced with fresh carbon.

(7) For a carbon adsorption system operated subject to requirements specified in § 264.1033(h)(1), a log that records:

(i) Date and time when control device is monitored for carbon breakthrough and the monitoring device reading.

(ii) Date when existing carbon in the control device is replaced with fresh carbon.

(8) Date of each control device startup and shutdown.

(d) Records of the monitoring, operating, and inspection information required by paragraphs (c)(3)–(c)(8) of this section need be kept only 3 years.

(e) For a control device other than a thermal vapor incinerator, catalytic vapor incinerator, flare, boiler, process heater, condenser, or carbon adsorption system, the Regional Administrator will specify the appropriate recordkeeping requirements.

(f) Up-to-date information and data used to determine whether or not a process vent is subject to the requirements in § 264.1032 including supporting documentation as required by § 264.1034(d)(2) when application of the knowledge of the nature of the hazardous waste stream or the process by which it was produced is used, shall be recorded in a log that is kept in the facility operating record.

(Approved by the Office of Management and Budget under control number 2060–0195)

### § 264.1036 Reporting requirements.

(a) A semiannual report shall be submitted by owners and operators subject to the requirements of this subpart to the Regional Administrator by dates specified by the Regional Administrator. The report shall include the following information:

(1) The Environmental Protection Agency identification number, name, and address of the facility.

(2) For each month during the semiannual reporting period, dates when the control device exceeded or operated outside of the design specifications as defined in § 264.1035(c)(4) and as indicated by the control device monitoring required by § 264.1033(f) and such exceedances were not corrected within 24 hours, or that a flare operated with visible emissions as defined in § 264.1033(d) and as determined by Method 22 monitoring, the duration and cause of each exceedance or visible emissions, and any corrective measures taken.

(b) If, during the semiannual reporting period, the control device does not exceed or operate outside of the design specifications as defined in § 264.1035(c)(4) for more than 24 hours or a flare does not operate with visible emissions as defined in § 264.1033(d), a report to the Regional Administrator is not required.

(Approved by the Office of Management and Budget under control number 2060–0195)

### §§ 264.1037–264.1049 [Reserved].

11. 40 CFR part 264 is amended by adding subpart BB to read as follows:

**Subpart BB—Air Emission Standards for Equipment Leaks**

264.1050 Applicability.
264.1051 Definitions.
264.1052 Standards: Pumps in light liquid service.
264.1053 Standards: Compressors.
264.1054 Standards: Pressure relief devices in gas/vapor service.
264.1055 Standards: Sampling connecting systems.
264.1056 Standards: Open-ended valves or lines.
264.1057 Standards: Valves in gas/vapor service or in light liquid service.
264.1058 Standards: Pumps and valves in heavy liquid service, pressure relief devices in light liquid or heavy liquid service, and flanges and other connectors.
264.1059 Standards: Delay of repair.
264.1060 Standards: Closed-vent systems and control devices.
264.1061 Alternative standards for valves in gas/vapor service or in light liquid service: percentage of valves allowed to leak.
264.1062 Alternative standards for valves in gas/vapor service or in light liquid service: skip period leak detection and repair.
264.1063 Test methods and procedures.
264.1064 Recordkeeping requirements.
264.1065 Reporting requirements.
264.1066–264.1079 [Reserved]

## Subpart BB—Air Emission Standards for Equipment Leaks

### § 264.1050 Applicability.

(a) The regulations in this subpart apply to owners and operators of facilities that treat, store, or dispose of hazardous wastes (except as provided in § 264.1).

(b) Except as provided in § 264.1064(k), this subpart applies to equipment that contains or contacts hazardous wastes with organic concentrations of at least 10 percent by weight that are managed in:

(1) Units that are subject to the permitting requirements of part 270, or

(2) Hazardous waste recycling units that are located on hazardous waste management facilities otherwise subject to the permitting requirements of part 270.

(c) If the owner or operator of equipment subject to the requirements of §§ 264.1052 through 264.1065 has received a permit under section 3005 of RCRA prior to December 21, 1990, the requirements of §§ 264.1052 through 264.1065 must be incorporated when the permit is reissued under § 124.15 or reviewed under § 270.50.

(d) Each piece of equipment to which this subpart applies shall be marked in such a manner that it can be distinguished readily from other pieces of equipment.

(e) Equipment that is in vacuum service is excluded from the requirements of § 264.1052 to § 264.1060 if it is identified as required in § 264.1064(g)(5).

[Note: The requirements of §§ 264.1052 through 264.1065 apply to equipment associated with hazardous waste recycling units previously exempt under § 261.6(c)(1). Other exemptions under §§ 261.4, 262.34, and 264.1(g) are not affected by these requirements.]

### § 264.1051 Definitions.

As used in this subpart, all terms shall have the meaning given them in § 264.1031, the Act, and parts 260–266.

### § 264.1052 Standards: Pumps in light liquid service.

(a)(1) Each pump in light liquid service shall be monitored monthly to detect leaks by the methods specified in § 264.1063(b), except as provided in paragraphs (d), (e), and (f) of this section.

(2) Each pump in light liquid service shall be checked by visual inspection each calendar week for indications of liquids dripping from the pump seal.

(b)(1) If a instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(2) If there are indications of liquids dripping from the pump seal, a leak is detected.

(c)(1) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 264.1059.

(2) A first attempt at repair (e.g., tightening the packing gland) shall be made no later than 5 calendar days after each leak is detected.

(d) Each pump equipped with a dual mechanical seal system that includes a barrier fluid system is exempt from the requirements of paragraph (a) of this section, *provided* the following requirements are met:

(1) Each dual mechanical seal system must be:

(i) Operated with the barrier fluid at a pressure that is at all times greater than the pump stuffing box pressure, or

(ii) Equipped with a barrier fluid degassing reservoir that is connected by a closed-vent system to a control device that complies with the requirements of § 264.1060, or

(iii) Equipped with a system that purges the barrier fluid into a hazardous waste stream with no detectable emissions to the atmosphere.

(2) The barrier fluid system must not be a hazardous waste with organic concentrations 10 percent or greater by weight.

(3) Each barrier fluid system must be equipped with a sensor that will detect failure of the seal system, the barrier fluid system, or both.

(4) Each pump must be checked by visual inspection, each calendar week, for indications of liquids dripping from the pump seals.

(5)(i) Each sensor as described in paragraph (d)(3) of this section must be checked daily or be equipped with an audible alarm that must be checked monthly to ensure that it is functioning properly.

(ii) The owner or operator must determine, based on design considerations and operating experience, a criterion that indicates failure of the seal system, the barrier fluid system, or both.

(6)(i) If there are indications of liquids dripping from the pump seal or the sensor indicates failure of the seal system, the barrier fluid system, or both based on the criterion determined in paragraph (d)(5)(ii) of this section, a leak is detected.

(ii) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 264.1059.

(iii) A first attempt at repair (e.g., relapping the seal) shall be made no later than 5 calendar days after each leak is detected.

(e) Any pump that is designated, as described in § 264.1064(g)(2), for no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, is exempt from the requirements of paragraphs (a), (c), and (d) of this section if the pump meets the following requirements:

(1) Must have no externally actuated shaft penetrating the pump housing.

(2) Must operate with no detectable emissions as indicated by an instrument reading of less than 500 ppm above background as measured by the methods specified in § 264.1063(c).

(3) Must be tested for compliance with paragraph (e)(2) of this section initially upon designation, annually, and at other times as requested by the Regional Administrator.

(f) If any pump is equipped with a closed-vent system capable of capturing and transporting any leakage from the seal or seals to a control device that complies with the requirements of § 264.1060, it is exempt from the requirements of paragraphs (a) through (e) of this section.

### § 264.1053 Standards: Compressors.

(a) Each compressor shall be equipped with a seal system that includes a barrier fluid system and that prevents leakage of total organic emissions to the atmosphere, except as provided in paragraphs (h) and (i) of this section.

(b) Each compressor seal system as required in paragraph (a) of this section shall be:

(1) Operated with the barrier fluid at a pressure that is at all times greater than the compressor stuffing box pressure, or

(2) Equipped with a barrier fluid system that is connected by a closed-vent system to a control device that complies with the requirements of § 264.1060, or

(3) Equipped with a system that purges the barrier fluid into a hazardous waste stream with no detectable emissions to atmosphere.

(c) The barrier fluid must not be a hazardous waste with organic concentrations 10 percent or greater by weight.

(d) Each barrier fluid system as described in paragraphs (a) through (c) of this section shall be equipped with a sensor that will detect failure of the seal system, barrier fluid system, or both.

(e)(1) Each sensor as required in paragraph (d) of this section shall be checked daily or shall be equipped with an audible alarm that must be checked monthly to ensure that it is functioning properly unless the compressor is located within the boundary of an unmanned plant site, in which case the sensor must be checked daily.

(2) The owner or operator shall determine, based on design considerations and operating experience, a criterion that indicates failure of the seal system, the barrier fluid system, or both.

(f) If the sensor indicates failure of the seal system, the barrier fluid system, or both based on the criterion determined under paragraph (e)(2) of this section, a leak is detected.

(g)(1) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 264.1059.

(2) A first attempt at repair (e.g., tightening the packing gland) shall be made no later than 5 calendar days after each leak is detected.

(h) A compressor is exempt from the requirements of paragraphs (a) and (b) of this section if it is equipped with a closed-vent system capable of capturing and transporting any leakage from the seal to a control device that complies with the requirements of § 264.1060, except as provided in paragraph (i) of this section.

(i) Any compressor that is designated, as described in § 264.1064(g)(2), for no detectable emissions as indicated by an instrument reading of less than 500 ppm above background is exempt from the requirements of paragraphs (a) through (h) of this section if the compressor:

(1) Is determined to be operating with no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as measured by the method specified in § 264.1063(c).

(2) Is tested for compliance with paragraph (i)(1) of this section initially upon designation, annually, and at other times as requested by the Regional Administrator.

### § 264.1054 Standards: Pressure relief devices in gas/vapor service.

(a) Except during pressure releases, each pressure relief device in gas/vapor service shall be operated with no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as measured by the method specified in § 264.1063(c).

(b)(1) After each pressure release, the pressure relief device shall be returned to a condition of no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as soon as practicable, but no later than 5 calendar days after each pressure release, except as provided in § 264.1059.

(2) No later than 5 calendar days after the pressure release, the pressure relief device shall be monitored to confirm the condition of no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as

measured by the method specified in § 264.1063(c).

(c) Any pressure relief device that is equipped with a closed-vent system capable of capturing and transporting leakage from the pressure relief device to a control device as described in § 264.1060 is exempt from the requirements of paragraphs (a) and (b) of this section.

### § 264.1055 Standards: Sampling connecting systems.

(a) Each sampling connection system shall be equipped with a closed purge system or closed-vent system.

(b) Each closed-purge system or closed-vent system as required in paragraph (a) shall:

(1) Return the purged hazardous waste stream directly to the hazardous waste management process line with no detectable emissions to atmosphere, or

(2) Collect and recycle the purged hazardous waste stream with no detectable emissions to atmosphere, or

(3) Be designed and operated to capture and transport all the purged hazardous waste stream to a control device that complies with the requirements of § 264.1060.

(c) *In situ* sampling systems are exempt from the requirements of paragraphs (a) and (b) of this section.

### § 264.1056 Standards: Open-ended valves or lines.

(a)(1) Each open-ended valve or line shall be equipped with a cap, blind flange, plug, or a second valve.

(2) The cap, blind flange, plug, or second valve shall seal the open end at all times except during operations requiring hazardous waste stream flow through the open-ended valve or line.

(b) Each open-ended valve or line equipped with a second valve shall be operated in a manner such that the valve on the hazardous waste stream end is closed before the second valve is closed.

(c) When a double block and bleed system is being used, the bleed valve or line may remain open during operations that require venting the line between the block valves but shall comply with paragraph (a) of this section at all other times.

### § 264.1057 Standards: Valves in gas/vapor service or in light liquid service.

(a) Each valve in gas/vapor or light liquid service shall be monitored monthly to detect leaks by the methods specified in § 264.1063(b) and shall comply with paragraphs (b) through (e) of this section, except as provided in paragraphs (f), (g), and (h) of this section, and §§ 264.1061 and 264.1062.

(b) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(c)(1) Any valve for which a leak is not detected for two successive months may be monitored the first month of every succeeding quarter, beginning with the next quarter, until a leak is detected.

(2) If a leak is detected, the valve shall be monitored monthly until a leak is not detected for two successive months.

(d)(1) When a leak is detected, it shall be repaired as soon as practicable, but no later than 15 calendar days after the leak is detected, except as provided in § 264.1059.

(2) A first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

(e) First attempts at repair include, but are not limited to, the following best practices where practicable:

(1) Tightening of bonnet bolts.

(2) Replacement of bonnet bolts.

(3) Tightening of packing gland nuts.

(4) Injection of lubricant into lubricated packing.

(f) Any valve that is designated, as described in § 264.1064(g)(2), for no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, is exempt from the requirements of paragraph (a) of this section if the valve:

(1) Has no external actuating mechanism in contact with the hazardous waste stream.

(2) Is operated with emissions less than 500 ppm above background as determined by the method specified in § 264.1063(c).

(3) Is tested for compliance with paragraph (f)(2) of this section initially upon designation, annually, and at other times as requested by the Regional Administrator.

(g) Any valve that is designated, as described in § 264.1064(h)(1), as an unsafe-to-monitor valve is exempt from the requirements of paragraph (a) of this section if:

(1) The owner or operator of the valve determines that the valve is unsafe to monitor because monitoring personnel would be exposed to an immediate danger as a consequence of complying with paragraph (a) of this section.

(2) The owner or operator of the valve adheres to a written plan that requires monitoring of the valve as frequently as practicable during safe-to-monitor times.

(h) Any valve that is designated, as described in § 264.1064(h)(2), as a difficult-to-monitor valve is exempt from the requirements of paragraph (a) of this section if:

(1) The owner or operator of the valve determines that the valve cannot be monitored without elevating the monitoring personnel more than 2 meters above a support surface.

(2) The hazardous waste management unit within which the valve is located was in operation before June 21, 1990.

(3) The owner or operator of the valve follows a written plan that requires monitoring of the valve at least once per calendar year.

### § 264.1058 Standards: Pumps and valves in heavy liquid service, pressure relief devices in light liquid or heavy liquid service, and flanges and other connectors.

(a) Pumps and valves in heavy liquid service, pressure relief devices in light liquid or heavy liquid service, and flanges and other connectors shall be monitored within 5 days by the method specified in § 264.1063(b) if evidence of a potential leak is found by visual, audible, olfactory, or any other detection method.

(b) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(c)(1) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 264.1059.

(2) The first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

(d) First attempts at repair include, but are not limited to, the best practices described under § 264.1057(e).

### § 264.1059 Standards: Delay of repair.

(a) Delay of repair of equipment for which leaks have been detected will be allowed if the repair is technically infeasible without a hazardous waste management unit shutdown. In such a case, repair of this equipment shall occur before the end of the next hazardous waste management unit shutdown.

(b) Delay of repair of equipment for which leaks have been detected will be allowed for equipment that is isolated from the hazardous waste management unit and that does not continue to contain or contact hazardous waste with organic concentrations at least 10 percent by weight.

(c) Delay of repair for valves will be allowed if:

(1) The owner or operator determines that emissions of purged material resulting from immediate repair are greater than the emissions likely to result from delay of repair.

(2) When repair procedures are effected, the purged material is collected and destroyed or recovered in a control device complying with § 264.1060.

(d) Delay of repair for pumps will be allowed if:

(1) Repair requires the use of a dual mechanical seal system that includes a barrier fluid system.

(2) Repair is completed as soon as practicable, but not later than 6 months after the leak was detected.

(e) Delay of repair beyond a hazardous waste management unit shutdown will be allowed for a valve if valve assembly replacement is necessary during the hazardous waste management unit shutdown, valve assembly supplies have been depleted, and valve assembly supplies had been sufficiently stocked before the supplies were depleted. Delay of repair beyond the next hazardous waste management unit shutdown will not be allowed unless the next hazardous waste management unit shutdown occurs sooner than 6 months after the first hazardous waste management unit shutdown.

### § 264.1060 Standards: Closed-vent systems and control devices.

Owners or operators of closed-vent systems and control devices shall comply with the provisions of § 264.1033.

### § 264.1061 Alternative standards for valves in gas/vapor service or in light liquid service: percentage of valves allowed to leak.

(a) An owner or operator subject to the requirements of § 264.1057 may elect to have all valves within a hazardous waste management unit comply with an alternative standard that allows no greater than 2 percent of the valves to leak.

(b) The following requirements shall be met if an owner or operator decides to comply with the alternative standard of allowing 2 percent of valves to leak:

(1) An owner or operator must notify the Regional Administrator that the owner or operator has elected to comply with the requirements of this section.

(2) A performance test as specified in paragraph (c) of this section shall be conducted initially upon designation, annually, and at other times requested by the Regional Administrator.

(3) If a valve leak is detected, it shall be repaired in accordance with § 264.1057(d) and (e).

(c) Performance tests shall be conducted in the following manner:

(1) All valves subject to the requirements in § 264.1057 within the hazardous waste management unit shall be monitored within 1 week by the methods specified in § 264.1063(b).

(2) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(3) The leak percentage shall be determined by dividing the number of valves subject to the requirements in § 264.1057 for which leaks are detected by the total number of valves subject to the requirements in § 264.1057 within the hazardous waste management unit.

(d) If an owner or operator decides to comply with this section no longer, the owner or operator must notify the Regional Administrator in writing that the work practice standard described in § 264.1057(a) through (e) will be followed.

### § 264.1062 Alternative standards for valves in gas/vapor service or in light liquid service: skip period leak detection and repair.

(a)(1) An owner or operator subject to the requirements of § 264.1057 may elect for all valves within a hazardous waste management unit to comply with one of the alternative work practices specified in paragraphs (b) (2) and (3) of this section.

(2) An owner or operator must notify the Regional Administrator before implementing one of the alternative work practices.

(b)(1) An owner or operator shall comply with the requirements for valves, as described in § 264.1057, except as described in paragraphs (b)(2) and (b)(3) of this section.

(2) After two consecutive quarterly leak detection periods with the percentage of valves leaking equal to or less than 2 percent, an owner or operator may begin to skip one of the quarterly leak detection periods for the valves subject to the requirements in § 264.1057.

(3) After five consecutive quarterly leak detection periods with the percentage of valves leaking equal to or less than 2 percent, an owner or operator may begin to skip three of the quarterly leak detection periods for the valves subject to the requirements in § 264.1057.

(4) If the percentage of valves leaking is greater than 2 percent, the owner or operator shall monitor monthly in compliance with the requirements in § 264.1057, but may again elect to use this section after meeting the requirements of § 264.1057(c)(1).

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### § 264.1063 Test methods and procedures.

(a) Each owner or operator subject to the provisions of this subpart shall comply with the test methods and procedures requirements provided in this section.

(b) Leak detection monitoring, as required in §§ 264.1052–264.1062, shall comply with the following requirements:

(1) Monitoring shall comply with Reference Method 21 in 40 CFR part 60.

(2) The detection instrument shall meet the performance criteria of Reference Method 21.

(3) The instrument shall be calibrated before use on each day of its use by the procedures specified in Reference Method 21.

(4) Calibration gases shall be:

(i) Zero air (less than 10 ppm of hydrocarbon in air).

(ii) A mixture of methane or n-hexane and air at a concentration of approximately, but less than, 10,000 ppm methane or n-hexane.

(5) The instrument probe shall be traversed around all potential leak interfaces as close to the interface as possible as described in Reference Method 21.

(c) When equipment is tested for compliance with no detectable emissions, as required in §§ 264.1052(e), 264.1053(i), 264.1054, and 264.1057(f), the test shall comply with the following requirements:

(1) The requirements of paragraphs (b)(1) through (4) of this section shall apply.

(2) The background level shall be determined as set forth in Reference Method 21.

(3) The instrument probe shall be traversed around all potential leak interfaces as close to the interface as possible as described in Reference Method 21.

(4) The arithmetic difference between the maximum concentration indicated by the instrument and the background level is compared with 500 ppm for determining compliance.

(d) In accordance with the waste analysis plan required by § 264.13(b), an owner or operator of a facility must determine, for each piece of equipment, whether the equipment contains or contacts a hazardous waste with organic concentration that equals or exceeds 10 percent by weight using the following:

(1) Methods described in ASTM Methods D 2267–88, E 169–87, E 168–88, E 260–85 (incorporated by reference under § 260.11);

(2) Method 9060 or 8240 of SW–846 (incorporated by reference under § 260.11); or

(3) Application of the knowledge of the nature of the hazardous waste stream or the process by which it was produced. Documentation of a waste determination by knowledge is required. Examples of documentation that shall

be used to support a determination under this provision include production process information documenting that no organic compounds are used, information that the waste is generated by a process that is identical to a process at the same or another facility that has previously been demonstrated by direct measurement to have a total organic content less than 10 percent, or prior speciation analysis results on the same waste stream where it can also be documented that no process changes have occurred since that analysis that could affect the waste total organic concentration.

(e) If an owner or operator determines that a piece of equipment contains or contacts a hazardous waste with organic concentrations at least 10 percent by weight, the determination can be revised only after following the procedures in paragraph (d)(1) or (d)(2) of this section.

(f) When an owner or operator and the Regional Administrator do not agree on whether a piece of equipment contains or contacts a hazardous waste with organic concentrations at least 10 percent by weight, the procedures in paragraph (d)(1) or (d)(2) of this section can be used to resolve the dispute.

(g) Samples used in determining the percent organic content shall be representative of the highest total organic content hazardous waste that is expected to be contained in or contact the equipment.

(h) To determine if pumps or valves are in light liquid service, the vapor pressures of constituents may be obtained from standard reference texts or may be determined by ASTM D–2879–86 (incorporated by reference under § 260.11).

(i) Performance tests to determine if a control device achieves 95 weight percent organic emission reduction shall comply with the procedures of § 264.1034(c)(1) through (c)(4).

### § 264.1064 Recordkeeping requirements.

(a)(1) Each owner or operator subject to the provisions of this subpart shall comply with the recordkeeping requirements of this section.

(2) An owner or operator of more than one hazardous waste management unit subject to the provisions of this subpart may comply with the recordkeeping requirements for these hazardous waste management units in one recordkeeping system if the system identifies each record by each hazardous waste management unit.

(b) Owners and operators must record the following information in the facility operating record:

(1) For each piece of equipment to which Subpart BB of Part 264 applies:

(i) Equipment identification number and hazardous waste management unit identification.

(ii) Approximate locations within the facility (e.g., identify the hazardous waste management unit on a facility plot plan).

(iii) Type of equipment (e.g., a pump or pipeline valve).

(iv) Percent-by-weight total organics in the hazardous waste stream at the equipment.

(v) Hazardous waste state at the equipment (e.g., gas/vapor or liquid).

(vi) Method of compliance with the standard (e.g., "monthly leak detection and repair" or "equipped with dual mechanical seals").

(2) For facilities that comply with the provisions of § 264.1033(a)(2), an implementation schedule as specified in § 264.1033(a)(2).

(3) Where an owner or operator chooses to use test data to demonstrate the organic removal efficiency or total organic compound concentration achieved by the control device, a performance test plan as specified in § 264.1035(b)(3).

(4) Documentation of compliance with § 264.1060, including the detailed design documentation or performance test results specified in § 264.1035(b)(4).

(c) When each leak is detected as specified in §§ 264.1052, 264.1053, 264.1057, and 264.1058, the following requirements apply:

(1) A weatherproof and readily visible identification, marked with the equipment identification number, the date evidence of a potential leak was found in accordance with § 264.1058(a), and the date the leak was detected, shall be attached to the leaking equipment.

(2) The identification on equipment, except on a valve, may be removed after it has been repaired.

(3) The identification on a valve may be removed after it has been monitored for 2 successive months as specified in §§ 264.1057(c) and no leak has been detected during those 2 months.

(d) When each leak is detected as specified in §§ 264.1052, 264.1053, 264.1057, and 264.1058, the following information shall be recorded in an inspection log and shall be kept in the facility operating record:

(1) The instrument and operator identification numbers and the equipment identification number.

(2) The date evidence of a potential leak was found in accordance with § 264.1058(a).

(3) The date the leak was detected and the dates of each attempt to repair the leak.

(4) Repair methods applied in each attempt to repair the leak.

(5) "Above 10,000" if the maximum instrument reading measured by the methods specified in § 264.1063(b) after each repair attempt is equal to or greater than 10,000 ppm.

(6) "Repair delayed" and the reason for the delay if a leak is not repaired within 15 calendar days after discovery of the leak.

(7) Documentation supporting the delay of repair of a valve in compliance with § 264.1059(c).

(8) The signature of the owner or operator (or designate) whose decision it was that repair could not be effected without a hazardous waste management unit shutdown.

(9) The expected date of successful repair of the leak if a leak is not repaired within 15 calendar days.

(10) The date of successful repair of the leak.

(e) Design documentation and monitoring, operating, and inspection information for each closed-vent system and control device required to comply with the provisions of § 264.1060 shall be recorded and kept up-to-date in the facility operating record as specified in § 264.1035(c). Design documentation is specified in § 264.1035 (c)(1) and (c)(2) and monitoring, operating, and inspection information in § 264.1035(c)(3)-(c)(8).

(f) For a control device other than a thermal vapor incinerator, catalytic vapor incinerator, flare, boiler, process heater, condenser, or carbon adsorption system, the Regional Administrator will specify the appropriate recordkeeping requirements.

(g) The following information pertaining to all equipment subject to the requirements in §§ 264.1052 through 264.1060 shall be recorded in a log that is kept in the facility operating record:

(1) A list of identification numbers for equipment (except welded fittings) subject to the requirements of this subpart.

(2)(i) A list of identification numbers for equipment that the owner or operator elects to designate for no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, under the provisions of §§ 264.1052(e), 264.1053(i), and 264.1057(f).

(ii) The designation of this equipment as subject to the requirements of §§ 264.1052(e), 264.1053(i), or 264.1057(f) shall be signed by the owner or operator.

(3) A list of equipment identification numbers for pressure relief devices required to comply with § 264.1054(a).

(4)(i) The dates of each compliance test required in §§ 264.1052(e), 264.1053(i), 264.1054, and 264.1057(f).

(ii) The background level measured during each compliance test.

(iii) The maximum instrument reading measured at the equipment during each compliance test.

(5) A list of identification numbers for equipment in vacuum service.

(h) The following information pertaining to all valves subject to the requirements of § 264.1057 (g) and (h) shall be recorded in a log that is kept in the facility operating record:

(1) A list of identification numbers for valves that are designated as unsafe to monitor, an explanation for each valve stating why the valve is unsafe to monitor, and the plan for monitoring each valve.

(2) A list of identification numbers for valves that are designated as difficult to monitor, an explanation for each valve stating why the valve is difficult to monitor, and the planned schedule for monitoring each valve.

(i) The following information shall be recorded in the facility operating record for valves complying with § 264.1062:

(1) A schedule of monitoring.

(2) The percent of valves found leaking during each monitoring period.

(j) The following information shall be recorded in a log that is kept in the facility operating record:

(1) Criteria required in § 264.1052(d)(5)(ii) and § 264.1053(e)(2) and an explanation of the design criteria.

(2) Any changes to these criteria and the reasons for the changes.

(k) The following information shall be recorded in a log that is kept in the facility operating record for use in determining exemptions as provided in the applicability section of this subpart and other specific subparts:

(1) An analysis determining the design capacity of the hazardous waste management unit.

(2) A statement listing the hazardous waste influent to and effluent from each hazardous waste management unit subject to the requirements in §§ 264.1052 through 264.1060 and an analysis determining whether these hazardous wastes are heavy liquids.

(3) An up-to-date analysis and the supporting information and data used to determine whether or not equipment is subject to the requirements in §§ 264.1052 through 264.1060. The record shall include supporting documentation as required by § 264.1063(d)(3) when application of the knowledge of the nature of the hazardous waste stream or the process by which it was produced is used. If the owner or operator takes any action (e.g., changing the process that produced the waste) that could result in an increase in the total organic content of the waste contained in or contacted by equipment determined not to be subject to the requirements in §§ 264.1052 through 264.1060, then a new determination is required.

(l) Records of the equipment leak information required by paragraph (d) of this section and the operating information required by paragraph (e) of this section need be kept only 3 years.

(m) The owner or operator of any facility that is subject to this subpart and to regulations at 40 CFR part 60, subpart VV, or 40 CFR part 61, subpart V, may elect to determine compliance with this subpart by documentation either pursuant to § 264.1064 of this subpart, or pursuant to those provisions of 40 CFR part 60 or 61, to the extent that the documentation under the regulation at 40 CFR part 60 or part 61 duplicates the documentation required under this subpart. The documentation under the regulation at 40 CFR part 60 or part 61 shall be kept with or made readily available with the facility operating record.

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### § 264.1065 Reporting requirements.

(a) A semiannual report shall be submitted by owners and operators subject to the requirements of this subpart to the Regional Administrator by dates specified by the Regional Administrator. The report shall include the following information:

(1) The Environmental Protection Agency identification number, name, and address of the facility.

(2) For each month during the semiannual reporting period:

(i) The equipment identification number of each valve for which a leak was not repaired as required in § 264.1057(d).

(ii) The equipment identification number of each pump for which a leak was not repaired as required in § 264.1052 (c) and (d)(6).

(iii) The equipment identification number of each compressor for which a leak was not repaired as required in § 264.1053(g).

(3) Dates of hazardous waste management unit shutdowns that occurred within the semiannual reporting period.

(4) For each month during the semiannual reporting period, dates when the control device installed as required by § 264.1052, 264.1053, 264.1054, or 264.1055 exceeded or operated outside of the design specifications as defined in § 264.1064(e) and as indicated by the control device monitoring required by § 264.1060 and was not corrected within 24 hours, the duration and cause of each exceedance, and any corrective measures taken.

(b) If, during the semiannual reporting period, leaks from valves, pumps, and compressors are repaired as required in §§ 264.1057 (d), 264.1052 (c) and (d)(6), and 264.1053 (g), respectively, and the control device does not exceed or operate outside of the design specifications as defined in § 264.1064(e) for more than 24 hours, a report to the Regional Administrator is not required.

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### §§ 264.1066–264.1079 [Reserved]

## PART 265—INTERIM STATUS STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

12. The authority citation for part 265 continues to read as follows:

**Authority:** 42 U.S.C. 6905, 6912(a), 6924, 6925, and 6935.

## Subpart B—General Facility Standards

13. Section 265.13 is amended by revising paragraph (b)(6) to read as follows:

### § 265.13 General waste analysis.

* * * * *

(b) * * *

(6) Where applicable, the methods that will be used to meet the additional waste analysis requirements for specific waste management methods as specified in §§ 265.193, 265.225, 265.252, 265.273, 265.314, 265.341, 265.375, 265.402, 265.1034(d), 265.1063(d), and 268.7 of this chapter.

14. Section 265.15 is amended by revising the last sentence of paragraph (b)(4) to read as follows:

### § 265.15 General inspection requirements.

* * * * *

(b) * * *

(4) * * * At a minimum, the inspection schedule must include the terms and frequencies called for in §§ 265.174, 265.193, 265.195, 265.226, 265.347, 265.377, 265.403, 265.1033, 265.1052, 265.1053, and 265.1058.

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## Subpart E—Manifest System, Recordkeeping, and Reporting

15. Section 265.73 is amended by revising paragraphs (b)(3) and (b)(6) to read as follows:

### § 265.73 Operating record.

* * * * *

(b) * * *

(3) Records and results of waste analyses and trial tests performed as specified in §§ 265.13, 265.193, 265.225, 265.252, 265.273, 265.314, 265.341, 265.375, 265.402, 265.1034, 265.1063, 268.4(a), and 268.7 of this chapter.

* * * * *

(6) Monitoring, testing or analytical data when required by §§ 265.90, 265.94, 265.191, 265.193, 265.195, 265.276, 265.278, 265.280(d)(1), 265.347, 265.377, 265.1034(c)–265.1034(f), 265.1035, 265.1063(d)–265.1063(i), and 265.1064.

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16. Section 265.77 is amended by adding paragraph (d) as follows:

### § 265.77 Additional reports.

* * * * *

(d) As otherwise required by Subparts AA and BB.

17. 40 CFR part 265 is amended by adding Subpart AA to read as follows:

Subpart AA—Air Emission Standards for Process Vents

265.1030 Applicability.
265.1031 Definitions.
265.1032 Standards: Process vents.
265.1033 Standards: Closed-vent systems and control devices.
265.1034 Test methods and procedures.
265.1035 Recordkeeping requirements.
265.1036—265.1049 [Reserved]

## Subpart AA—Air Emission Standards for Process Vents

### § 265.1030 Applicability.

(a) The regulations in this subpart apply to owners and operators of facilities that treat, store, or dispose of hazardous wastes (except as provided in § 265.1).

(b) Except for §§ 265.1034(d) and 265.1035(d), this subpart applies to process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations that manage hazardous wastes with organic concentrations of at least 10 ppmw, if these operations are conducted in:

(1) Units that are subject to the permitting requirements of part 270, or

(2) Hazardous waste recycling units that are located on hazardous waste management facilities otherwise subject to the permitting requirements of part 270.

[Note: The requirements of §§ 265.1032 through 265.1036 apply to process vents on hazardous waste recycling units previously exempt under paragraph 261.6(c)(1). Other exemptions under §§ 261.4, 262.34, and 265.1(c) are not affected by these requirements.]

### § 265.1031 Definitions.

As used in this subpart, all terms shall have the meaning given them in § 264.1031, the Act, and parts 260–266.

### § 265.1032 Standards: Process vents.

(a) The owner or operator of a facility with process vents associated with distillation, fractionation, thin-film evaporation, solvent extraction or air or steam stripping operations managing hazardous wastes with organic concentrations at least 10 ppmw shall either:

(1) Reduce total organic emissions from all affected process vents at the facility below 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 tons/yr), or

(2) Reduce, by use of a control device, total organic emissions from all affected process vents at the facility by 95 weight percent.

(b) If the owner or operator installs a closed-vent system and control device to comply with the provisions of paragraph (a) of this section, the closed-vent system and control device must meet the requirements of § 265.1033.

(c) Determinations of vent emissions and emission reductions or total organic compound concentrations achieved by add-on control devices may be based on engineering calculations or performance tests. If performance tests are used to determine vent emissions, emission reductions, or total organic compound concentrations achieved by add-on control devices, the performance tests must conform with the requirements of § 265.1034(c).

(d) When an owner or operator and the Regional Administrator do not agree on determinations of vent emissions and/or emission reductions or total organic compound concentrations achieved by add-on control devices based on engineering calculations, the test methods in § 265.1034(c) shall be used to resolve the disagreement.

### § 265.1033 Standards: Closed-vent systems and control devices.

(a)(1) Owners or operators of closed-vent systems and control devices used to comply with provisions of this part shall comply with the provisions of this section.

(2) The owner or operator of an existing facility who cannot install a closed-vent system and control device to comply with the provisions of this subpart on the effective date that the facility becomes subject to the provisions of this subpart must prepare an implementation schedule that includes dates by which the closed-vent system and control device will be installed and in operation. The controls must be installed as soon as possible, but the implementation schedule may allow up to 18 months after the effective date that the facility becomes subject to this subpart for installation and startup. All units that begin operation after December 21, 1990 must comply with the rules immediately (i.e., must have control devices installed and operating on startup of the affected unit); the 2-year implementation schedule does not apply to these units.

(b) A control device involving vapor recovery (e.g., a condenser or adsorber) shall be designed and operated to recover the organic vapors vented to it with an efficiency of 95 weight percent or greater unless the total organic emission limits of § 265.1032(a)(1) for all affected process vents can be attained at an efficiency less than 95 weight percent.

(c) An enclosed combustion device (e.g., a vapor incinerator, boiler, or process heater) shall be designed and operated to reduce the organic emissions vented to it by 95 weight percent or greater; to achieve a total organic compound concentration of 20 ppmv, expressed as the sum of the actual compounds, not carbon equivalents, on a dry basis corrected to 3 percent oxygen; or to provide a minimum residence time of 0.50 seconds at a minimum temperature of 760 °C. If a boiler or process heater is used as the control device, then the vent stream shall be introduced into the flame combustion zone of the boiler or process heater.

(d)(1) A flare shall be designed for and operated with no visible emissions as determined by the methods specified in paragraph (e)(1) of this section, except for periods not to exceed a total of 5 minutes during any 2 consecutive hours.

(2) A flare shall be operated with a flame present at all times, as determined by the methods specified in paragraph (f)(2)(iii) of this section.

(3) A flare shall be used only if the net heating value of the gas being combusted is 11.2 MJ/scm (300 Btu/scf) or greater, if the flare is steam-assisted or air-assisted; or if the net heating value of the gas being combusted is 7.45 MJ/scm (200 Btu/scf) or greater if the flare is nonassisted. The net heating value of the gas being combusted shall be determined by the methods specified in paragraph (e)(2) of this section.

(4)(i) A steam-assisted or nonassisted flare shall be designed for and operated with an exit velocity, as determined by the methods specified in paragraph (e)(3) of this section, of less than 18.3 m/s (60 ft/s), except as provided in paragraphs (d)(4) (ii) and (iii) of this section.

(ii) A steam-assisted or nonassisted flare designed for and operated with an exit velocity, as determined by the methods specified in paragraph (e)(3) of this section, equal to or greater than 18.3 m/s (60 ft/s) but less than 122 m/s (400 ft/s) is allowed if the net heating value of the gas being combusted is greater than 37.3 MJ/scm (1,000 Btu/scf).

(iii) A steam-assisted or nonassisted flare designed for and operated with an exit velocity, as determined by the methods specified in paragraph (e)(3) of this section, less than the velocity, $V_{max}$, as determined by the method specified in paragraph (e)(4) of this section, and less than 122 m/s (400 ft/s) is allowed.

(5) An air-assisted flare shall be designed and operated with an exit velocity less than the velocity, $V_{max}$, as determined by the method specified in paragraph (e)(5) of this section.

(6) A flare used to comply with this section shall be steam-assisted, air-assisted, or nonassisted.

(e)(1) Reference Method 22 in 40 CFR part 60 shall be used to determine the compliance of a flare with the visible emission provisions of this subpart. The observation period is 2 hours and shall be used according to Method 22.

(2) The net heating value of the gas being combusted in a flare shall be calculated using the following equation:

$$H_T = K \left[ \sum_{i=1}^{n} C_i H_i \right]$$

where:

$H_T$ = Net heating value of the sample, MJ/scm; where the net enthalpy per mole of offgas is based on combustion at 25 °C and 760 mm Hg, but the standard temperature for determining the volume corresponding to 1 mol is 20 °C;

K = Constant, $1.74 \times 10^{-7}$ (1/ppm) (g mol/scm) (MJ/kcal) where standard temperature for (g mol/scm) is 20 °C;

$C_i$ = Concentration of sample component i in ppm on a wet basis, as measured for organics by Reference Method 18 in 40 CFR part 60 and measured for hydrogen and carbon monoxide by ASTM D 1946–82 (incorporated by reference as specified in § 260.11); and

$H_i$ = Net heat of combustion of sample component i, kcal/g mol at 25 °C and 760 mm Hg. The heats of combustion may be determined using ASTM D 2382–83 (incorporated by reference as specified in § 260.11) if published values are not available or cannot be calculated.

(3) The actual exit velocity of a flare shall be determined by dividing the volumetric flow rate (in units of standard temperature and pressure), as determined by Reference Methods 2, 2A, 2C, or 2D in 40 CFR part 60 as appropriate, by the unobstructed (free) cross-sectional area of the flare tip.

(4) The maximum allowed velocity in m/s, $V_{max}$, for a flare complying with paragraph (d)(4)(iii) of this section shall be determined by the following equation:

$$\mathrm{Log}_{10}(V_{max}) = (H_T + 28.8)/31.7$$

where:

$H_T$ = The net heating value as determined in paragraph (e)(2) of this section.

28.8 = Constant.

31.7 = Constant.

(5) The maximum allowed velocity in m/s, $V_{max}$, for an air-assisted flare shall be determined by the following equation:

$$V_{max} = 8.706 + 0.7084\,(H_T)$$

where:

8.706 = Constant.

0.7084 = Constant.

$H_T$ = The net heating value as determined in paragraph (e)(2) of this section.

(f) The owner or operator shall monitor and inspect each control device required to comply with this section to ensure proper operation and maintenance of the control device by implementing the following requirements:

(1) Install, calibrate, maintain, and operate according to the manufacturer's specifications a flow indicator that provides a record of vent stream flow from each affected process vent to the control device at least once every hour. The flow indicator sensor shall be installed in the vent stream at the nearest feasible point to the control device inlet, but before being combined with other vent streams.

(2) Install, calibrate, maintain, and operate according to the manufacturer's specifications a device to continuously monitor control device operation as specified below:

(i) For a thermal vapor incinerator, a temperature monitoring device equipped with a continuous recorder. The device shall have an accuracy of ±1 percent of the temperature being monitored in °C or ±0.5 °C, whichever is greater. The temperature sensor shall be installed at a location in the combustion chamber downstream of the combustion zone.

(ii) For a catalytic vapor incinerator, a temperature monitoring device equipped with a continuous recorder. The device shall be capable of monitoring temperature at two locations and have an accuracy of ±1 percent of the temperature being monitored in °C or ±0.5 °C, whichever is greater. One temperature sensor shall be installed in the vent stream at the nearest feasible point to the catalyst bed inlet and a second temperature sensor shall be installed in the vent stream at the nearest feasible point to the catalyst bed outlet.

(iii) For a flare, a heat sensing monitoring device equipped with a continuous recorder that indicates the continuous ignition of the pilot flame.

(iv) For a boiler or process heater having a design heat input capacity less than 44 MW, a temperature monitoring device equipped with a continuous recorder. The device shall have an accuracy of ±1 percent of the temperature being monitored in °C or ±0.5 °C, whichever is greater. The temperature sensor shall be installed at a location in the furnace downstream of the combustion zone.

(v) For a boiler or process heater having a design heat input capacity greater than or equal to 44 MW, a monitoring device equipped with a continuous recorder to measure a parameter(s) that indicates good combustion operating practices are being used.

(vi) For a condenser, either:

(A) A monitoring device equipped with a continuous recorder to measure the concentration level of the organic compounds in the exhaust vent stream from the condenser; or

(B) A temperature monitoring device equipped with a continuous recorder. The device shall be capable of monitoring temperature at two locations and have an accuracy of ±1 percent of the temperature being monitored in °C or ±0.5 °C, whichever is greater. One temperature sensor shall be installed at a location in the exhaust vent stream from the condenser, and a second temperature sensor shall be installed at a location in the coolant fluid exiting the condenser.

(vii) For a carbon adsorption system such as a fixed-bed carbon adsorber that regenerates the carbon bed directly in the control device, either:

(A) A monitoring device equipped with a continuous recorder to measure the concentration level of the organic compounds in the exhaust vent stream from the carbon bed, or

(B) A monitoring device equipped with a continuous recorder to measure a parameter that indicates the carbon bed is regenerated on a regular, predetermined time cycle.

(3) Inspect the readings from each monitoring device required by paragraphs (f) (1) and (2) of this section at least once each operating day to check control device operation and, if necessary, immediately implement the corrective measures necessary to ensure the control device operates in compliance with the requirements of this section.

(g) An owner or operator using a carbon adsorption system such as a fixed-bed carbon adsorber that regenerates the carbon bed directly onsite in the control device, shall replace the existing carbon in the control device with fresh carbon at a regular, predetermined time interval that is no longer than the carbon service life established as a requirement of § 265.1035(b)(4)(iii)(F).

(h) An owner or operator using a carbon adsorption system such as a carbon canister that does not regenerate the carbon bed directly onsite in the control device shall replace the existing carbon in the control device with fresh carbon on a regular basis by using one of the following procedures:

(1) Monitor the concentration level of the organic compounds in the exhaust vent stream from the carbon adsorption system on a regular schedule and replace the existing carbon with fresh carbon immediately when carbon breakthrough is indicated. The monitoring frequency shall be daily or at an interval no greater than 20 percent of the time required to consume the total carbon working capacity established as a requirement of § 265.1035(b)(4)(iii)(G), whichever is longer.

(2) Replace the existing carbon with fresh carbon at a regular, predetermined time interval that is less than the design carbon replacement interval established as a requirement of § 265.1035(b)(4)(iii)(G).

(i) An owner or operator of an affected facility seeking to comply with the provisions of this part by using a control device other than a thermal vapor incinerator, catalytic vapor incinerator, flare, boiler, process heater, condenser, or carbon adsorption system is required to develop documentation including sufficient information to describe the control device operation and identify the process parameter or parameters that indicate proper operation and maintenance of the control device.

(j)(1) Closed-vent systems shall be designed for and operated with no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background and by visual inspections, as determined by the methods specified as § 265.1034(b).

(2) Closed-vent systems shall be monitored to determine compliance with this section during the initial leak detection monitoring which shall be conducted by the date that the facility becomes subject to the provisions of this section, annually, and at other times as requested by the Regional Administrator.

(3) Detectable emissions, as indicated by an instrument reading greater than 500 ppm and visual inspections, shall be controlled as soon as practicable, but not later than 15 calendar days after the emission is detected.

(4) A first attempt at repair shall be made no later than 5 calendar days after the emission is detected.

(k) Closed-vent systems and control devices used to comply with provisions of this subpart shall be operated at all times when emissions may be vented to them.

**§ 265.1034 Test methods and procedures.**

(a) Each owner or operator subject to the provisions of this subpart shall comply with the test methods and procedures requirements provided in this section.

(b) When a closed-vent system is tested for compliance with no detectable emissions, as required in § 265.1033(j), the test shall comply with the following requirements:

(1) Monitoring shall comply with Reference Method 21 in 40 CFR part 60.

(2) The detection instrument shall meet the performance criteria of Reference Method 21.

(3) The instrument shall be calibrated before use on each day of its use by the procedures specified in Reference Method 21.

(4) Calibration gases shall be

(i) Zero air (less than 10 ppm of hydrocarbon in air).

(ii) A mixture of methane or n-hexane and air at a concentration of approximately, but less than, 10,000 ppm methane or n-hexane.

(5) The background level shall be determined as set forth in Reference Method 21.

(6) The instrument probe shall be traversed around all potential leak interfaces as close to the interface as possible as described in Reference Method 21.

(7) The arithmetic difference between the maximum concentration indicated by the instrument and the background level is compared with 500 ppm for determining compliance.

(c) Performance tests to determine compliance with § 265.1032(a) and with the total organic compound concentration limit of § 265.1033(c) shall comply with the following:

(1) Performance tests to determine total organic compound concentrations and mass flow rates entering and exiting control devices shall be conducted and data reduced in accordance with the following reference methods and calculation procedures:

(i) Method 2 in 40 CFR part 60 for velocity and volumetric flow rate.

(ii) Method 18 in 40 CFR part 60 for organic content.

(iii) Each performance test shall consist of three separate runs; each run conducted for at least 1 hour under the conditions that exist when the hazardous waste management unit is operating at the highest load or capacity level reasonably expected to occur. For the purpose of determining total organic compound concentrations and mass flow rates, the average of results of all runs shall apply. The average shall be computed on a time-weighted basis.

(iv) Total organic mass flow rates shall be determined by the following equation:

$$E_h = Q_{2sd} \left[ \sum_{i=1}^{n} C_i MW_i \right] [0.0416] [10^{-6}]$$

where:

$E_h$ = Total organic mass flow rate, kg/h;

$Q_{2sd}$ = Volumetric flow rate of gases entering or exiting control device, as determined by Method 2, dscm/h;

n = Number of organic compounds in the vent gas;

$C_i$ = Organic concentration in ppm, dry basis, of compound i in the vent gas, as determined by Method 18;

$MW_i$ = Molecular weight of organic compound i in the vent gas, kg/kg-mol;

0.0416 = Conversion factor for molar volume, kg-mol/$m^3$ (@ 293 K and 760 mm Hg);
$10^{-6}$ = Conversion from ppm, $ppm^{-1}$.

(v) The annual total organic emission rate shall be determined by the following equation:

$$E_A = (E_h)(H)$$

where:

$E_A$ = Total organic mass emission rate, kg/y;
$E_h$ = Total organic mass flow rate for the process vent, kg/h;
H = Total annual hours of operations for the affected unit, h.

(vi) Total organic emissions from all affected process vents at the facility shall be determined by summing the hourly total organic mass emission rates ($E_h$, as determined in paragraph (c)(1)(v) of this section) and by summing the annual total organic mass emission rates ($E_A$, as determined in paragraph (c)(1)(v) of this section) for all affected process vents at the facility.

(2) The owner or operator shall record such process information as may be necessary to determine the conditions of the performance tests. Operations during periods of startup, shutdown, and malfunction shall not constitute representative conditions for the purpose of a performance test.

(3) The owner or operator of an affected facility shall provide, or cause to be provided, performance testing facilities as follows:

(i) Sampling ports adequate for the test methods specified in paragraph (c)(1) of this section.

(ii) Safe sampling platform(s).

(iii) Safe access to sampling platform(s).

(iv) Utilities for sampling and testing equipment.

(4) For the purpose of making compliance determinations, the time-weighted average of the results of the three runs shall apply. In the event that a sample is accidentally lost or conditions occur in which one of the three runs must be discontinued because of forced shutdown, failure of an irreplaceable portion of the sample train, extreme meteorological conditions, or other circumstances beyond the owner or operator's control, compliance may, upon the Regional Administrator's approval, be determined using the average of the results of the two other runs.

(d) To show that a process vent associated with a hazardous waste distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operation is not subject to the requirements of this subpart, the owner or operator must make an initial determination that the time-weighted, annual average total organic concentration of the waste managed by the waste management unit is less than 10 ppmw using one of the following two methods:

(1) Direct measurement of the organic concentration of the waste using the following procedures:

(i) The owner or operator must take a minimum of four grab samples of waste for each waste stream managed in the affected unit under process conditions expected to cause the maximum waste organic concentration.

(ii) For waste generated onsite, the grab samples must be collected at a point before the waste is exposed to the atmosphere such as in an enclosed pipe or other closed system that is used to transfer the waste after generation to the first affected distillation fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operation. For waste generated offsite, the grab samples must be collected at the inlet to the first waste management unit that receives the waste provided the waste has been transferred to the facility in a closed system such as a tank truck and the waste is not diluted or mixed with other waste.

(iii) Each sample shall be analyzed and the total organic concentration of the sample shall be computed using Method 9060 or 8240 of SW–846 (incorporated by reference under § 260.11).

(iv) The arithmetic mean of the results of the analyses of the four samples shall apply for each waste stream managed in the unit in determining the time-weighted, annual average total organic concentration of the waste. The time-weighted average is to be calculated using the annual quantity of each waste stream processed and the mean organic concentration of each waste stream managed in the unit.

(2) Using knowledge of the waste to determine that its total organic concentration is less than 10 ppmw. Documentation of the waste determination is required. Examples of documentation that shall be used to support a determination under this provision include production process information documenting that no organic compounds are used, information that the waste is generated by a process that is identical to a process at the same or another facility that has previously been demonstrated by direct measurement to generate a waste stream having a total organic content less than 10 ppmw, or prior speciation analysis results on the same waste stream where it can also be documented that no process changes have occurred since that analysis that could affect the waste total organic concentration.

(e) The determination that distillation fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operations manage hazardous wastes with time-weighted annual average total organic concentrations less than 10 ppmw shall be made as follows:

(1) By the effective date that the facility becomes subject to the provisions of this subpart or by the date when the waste is first managed in a waste management unit, whichever is later; and

(2) For continuously generated waste, annually; or

(3) Whenever there is a change in the waste being managed or a change in the process that generates or treats the waste.

(f) When an owner or operator and the Regional Administrator do not agree on whether a distillation, fractionation, thin-film evaporation, solvent extraction, or air or steam stripping operation manages a hazardous waste with organic concentrations of at least 10 ppmw based on knowledge of the waste, the procedures in Method 8240 can be used to resolve the dispute.

### § 265.1035 Recordkeeping requirements.

(a)(1) Each owner or operator subject to the provisions of this subpart shall comply with the recordkeeping requirements of this section.

(2) An owner or operator of more than one hazardous waste management unit subject to the provisions of this subpart may comply with the recordkeeping requirements for these hazardous waste management units in one recordkeeping system if the system identifies each record by each hazardous waste management unit.

(b) Owners and operators must record the following information in the facility operating record:

(1) For facilities that comply with the provisions of § 265.1033(a)(2), an implementation schedule that includes dates by which the closed-vent system and control device will be installed and in operation. The schedule must also include a rationale of why the installation cannot be completed at an earlier date. The implementation schedule must be in the facility operating record by the effective date that the facility becomes subject to the provisions of this subpart.

(2) Up-to-date documentation of compliance with the process vent standards in § 265.1032, including:

(i) Information and data identifying all affected process vents, annual throughput end operating hours of each affected unit, estimated emission rates for each affected vent and for the overall facility (i.e., the total emissions for all affected vents at the facility), and the approximate location within the facility of each affected unit (e.g., identify the hazardous waste management units on a facility plot plan); and

(ii) Information and data supporting determinations of vent emissions and emission reductions achieved by add-on control devices based on engineering calculations or source tests. For the purpose of determining compliance, determinations of vent emissions and emission reductions must be made using operating parameter values (e.g., temperatures, flow rates or vent stream organic compounds and concentrations) that represent the conditions that result in maximum organic emissions, such as when the waste management unit is operating at the highest load or capacity level reasonably expected to occur. If the owner or operator takes any action (e.g., managing a waste of different composition or increasing operating hours of affected waste management units) that would result in an increase in total organic emissions from affected process vents at the facility, then a new determination is required.

(3) Where an owner or operator chooses to use test data to determine the organic removal efficiency or total organic compound concentration achieved by the control device, a performance test plan. The test plan must include:

(i) A description of how it is determined that the planned test is going to be conducted when the hazardous waste management unit is operating at the highest load or capacity level reasonably expected to occur. This shall include the estimated or design flow rate and organic content of each vent stream and define the acceptable operating ranges of key process and control device parameters during the test program.

(ii) A detailed engineering description of the closed-vent system and control device including:

(A) Manufacturer's name and model number of control device.

(B) Type of control device.

(C) Dimensions of the control device.

(D) Capacity.

(E) Construction materials.

(iii) A detailed description of sampling and monitoring procedures, including sampling and monitoring locations in the system, the equipment to be used, sampling and monitoring frequency, and planned analytical procedures for sample analysis.

(4) Documentation of compliance with § 265.1033 shall include the following information:

(i) A list of all information references and sources used in preparing the documentation.

(ii) Records including the dates of each compliance test required by § 265.1033(j).

(iii) If engineering calculations are used, a design analysis, specifications, drawings, schematics, and piping and instrumentation diagrams based on the appropriate sections of "APTI Course 415: Control of Gaseous Emissions" (incorporated by reference as specified in § 260.11) or other engineering texts acceptable to the Regional Administrator that present basic control device design information. Documentation provided by the control device manufacturer or vendor that describes the control device design in accordance with paragraphs (b)(4)(iii)(A) through (b)(4)(iii)(G) of this section may be used to comply with this requirement. The design analysis shall address the vent stream characteristics and control device operation parameters as specified below.

(A) For a thermal vapor incinerator, the design analysis shall consider the vent stream composition, constituent concentrations, and flow rate. The design analysis shall also establish the design minimum and average temperature in the combustion zone and the combustion zone residence time.

(B) For a catalytic vapor incinerator, the design analysis shall consider the vent stream composition, constituent concentrations, and flow rate. The design analysis shall also establish the design minimum and average temperatures across the catalyst bed inlet and outlet.

(C) For a boiler or process heater, the design analysis shall consider the vent stream composition, constituent concentrations, and flow rate. The design analysis shall also establish the design minimum and average flame zone temperatures, combustion zone residence time, and description of method and location where the vent stream is introduced into the combustion zone.

(D) For a flare, the design analysis shall consider the vent stream composition, constituent concentrations, and flow rate. The design analysis shall also consider the requirements specified in § 265.1033(d).

(E) For a condenser, the design analysis shall consider the vent stream composition, constituent concentrations, flow rate, relative humidity, and temperature. The design analysis shall also establish the design outlet organic compound concentration level, design average temperature of the condenser exhaust vent stream, and design average temperatures of the coolant fluid at the condenser inlet and outlet.

(F) For a carbon adsorption system such as a fixed-bed adsorber that regenerates the carbon bed directly onsite in the control device, the design analysis shall consider the vent stream composition, constituent concentrations, flow rate, relative humidity, and temperature. The design analysis shall also establish the design exhaust vent stream organic compound concentration level, number and capacity of carbon beds, type and working capacity of activated carbon used for carbon beds, design total steam flow over the period of each complete carbon bed regeneration cycle, duration of the carbon bed steaming and cooling/drying cycles, design carbon bed temperature after regeneration, design carbon bed regeneration time, and design service life of carbon.

(G) For a carbon adsorption system such as a carbon canister that does not regenerate the carbon bed directly onsite in the control device, the design analysis shall consider the vent stream composition, constituent concentrations, flow rate, relative humidity, and temperature. The design analysis shall also establish the design outlet organic concentration level, capacity of carbon bed, type and working capacity of activated carbon used for carbon bed, and design carbon replacement interval based on the total carbon working capacity of the control device and source operating schedule.

(iv) A statement signed and dated by the owner or operator certifying that the operating parameters used in the design analysis reasonably represent the conditions that exist when the hazardous waste management unit is or would be operating at the highest load or capacity level reasonably expected to occur.

(v) A statement signed and dated by the owner or operator certifying that the control device is designed to operate at an efficiency of 95 percent or greater unless the total organic concentration limit of § 265.1032(a) is achieved at an efficiency less than 95 weight percent or the total organic emission limits of § 265.1032(a) for affected process vents at the facility can be attained by a control device involving vapor recovery at an efficiency less than 95 weight percent. A statement provided by the control device manufacturer or vendor certifying that the control equipment meets the design specifications may be used to comply with this requirement.

(vi) If performance tests are used to demonstrate compliance, all test results.

(c) Design documentation and monitoring, operating, and inspection information for each closed-vent system and control device required to comply with the provisions of this part shall be recorded and kept up-to-date in the facility operating record. The information shall include:

(1) Description and date of each modification that is made to the closed-vent system or control device design.

(2) Identification of operating parameter, description of monitoring device, and diagram of monitoring sensor location or locations used to comply with § 265.1033(f)(1) and (f)(2).

(3) Monitoring, operating and inspection information required by paragraphs (f) through (j) of § 265.1033.

(4) Date, time, and duration of each period that occurs while the control device is operating when any monitored parameter exceeds the value established in the control device design analysis as specified below:

(i) For a thermal vapor incinerator designed to operate with a minimum residence time of 0.50 seconds at a minimum temperature of 760 °C, period when the combustion temperature is below 760 °C.

(ii) For a thermal vapor incinerator designed to operate with an organic emission reduction efficiency of 95 percent or greater, period when the combustion zone temperature is more than 28 °C below the design average combustion zone temperature established as a requirement of paragraph (b)(4)(iii)(A) of this section.

(iii) For a catalytic vapor incinerator, period when:

(A) Temperature of the vent stream at the catalyst bed inlet is more than 28 °C below the average temperature of the inlet vent stream established as a requirement of paragraph (b)(4)(iii)(B) of this section; or

(B) Temperature difference across the catalyst bed is less than 80 percent of the design average temperature difference established as a requirement of paragraph (b)(4)(iii)(B) of this section.

(iv) For a boiler or process heater, period when:

(A) Flame zone temperature is more than 28 °C below the design average flame zone temperature established as a requirement of paragraph (b)(4)(iii)(C) of this section; or

(B) Position changes where the vent stream is introduced to the combustion zone from the location established as a requirement of paragraph (b)(4)(iii)(C) of this section.

(v) For a flare, period when the pilot flame is not ignited.

(vi) For a condenser that complies with § 265.1033(f)(2)(vi)(A), period when the organic compound concentration level or readings of organic compounds in the exhaust vent stream from the condenser are more than 20 percent greater than the design outlet organic compound concentration level established as a requirement of paragraph (b)(4)(iii)(E) of this section.

(vii) For a condenser that complies with § 265.1033(f)(2)(vi)(B), period when:

(A) Temperature of the exhaust vent stream from the condenser is more than 6 °C above the design average exhaust vent stream temperature established as a requirement of paragraph (b)(4)(iii)(E) of this section; or

(B) Temperature of the coolant fluid exiting the condenser is more than 6 °C above the design average coolant fluid temperature at the condenser outlet established as a requirement of paragraph (b)(4)(iii)(E) of this section.

(viii) For a carbon adsorption system such as a fixed-bed carbon adsorber that regenerates the carbon bed directly onsite in the control device and complies with § 265.1033(f)(2)(vii)(A), period when the organic compound concentration level or readings of organic compounds in the exhaust vent stream from the carbon bed are more than 20 percent greater than the design exhaust vent stream organic compound concentration level established as a requirement of paragraph (b)(4)(iii)(F) of this section.

(ix) For a carbon adsorption system such as a fixed-bed carbon adsorber that regenerates the carbon bed directly onsite in the control device and complies with § 265.1033(f)(2)(vii)(B), period when the vent stream continues to flow through the control device beyond the predetermined carbon bed regeneration time established as a requirement of paragraph (b)(4)(iii)(F) of this section..

(5) Explanation for each period recorded under paragraph (3) of the cause for control device operating parameter exceeding the design value and the measures implemented to correct the control device operation.

(6) For carbon adsorption systems operated subject to requirements specified in § 265.1033(g) or § 265.1033(h)(2), date when existing carbon in the control device is replaced with fresh carbon.

(7) For carbon adsorption systems operated subject to requirements specified in § 265.1033(h)(1), a log that records:

(i) Date and time when control device is monitored for carbon breakthrough and the monitoring device reading.

(ii) Date when existing carbon in the control device is replaced with fresh carbon.

(8) Date of each control device startup and shutdown.

(d) Records of the monitoring, operating, and inspection information required by paragraphs (c)(3) through (c)(8) of this section need be kept only 3 years.

(e) For a control device other than a thermal vapor incinerator, catalytic vapor incinerator, flare, boiler, process heater, condenser, or carbon adsorption system, monitoring and inspection information indicating proper operation and maintenance of the control device must be recorded in the facility operating record.

(f) Up-to-date information and data used to determine whether or not a process vent is subject to the requirements in § 265.1032 including supporting documentation as required by § 265.1034(d)(2) when application of the knowledge of the nature of the hazardous waste stream or the process by which it was produced is used, shall be recorded in a log that is kept in the facility operating record.

(Approved by the Office of Management and Budget under control number 2060-0195)

### §§ 265.1036–265.1049 [Reserved]

18. 40 CFR part 265 is amended by adding subpart BB to read as follows:

### Subpart BB—Air Emission Standards for Equipment Leaks

265.1050 Applicability.
265.1051 Definitions.
265.1052 Standards: Pumps in light liquid service.
265.1053 Standards: Compressors.
265.1054 Standards: Pressure relief devices in gas/vapor service.
265.1055 Standards: Sampling connecting systems.
265.1056 Standards: Open-ended valves or lines.
265.1057 Standards: Valves in gas/vapor service or in light liquid service.
265.1058 Standards: Pumps and valves in heavy liquid service, pressure relief devices in light liquid or heavy liquid service, and flanges and other connectors.
265.1059 Standards: Delay of repair.
265.1060 Standards: Closed-vent systems and control devices.
265.1061 Alternative standards for valves in gas/vapor service or in light liquid service: percentage of valves allowed to leak.
265.1062 Alternative standards for valves in gas/vapor service or in light liquid service: skip period leak detection and repair.
265.1063 Test methods and procedures.
265.1064 Recordkeeping requirements.
265.1065–265.1079 [Reserved]

## Subpart BB—Air Emission Standards for Equipment Leaks

### § 265.1050 Applicability.

(a) The regulations in this subpart apply to owners and operators of facilities that treat, store, or dispose of hazardous wastes (except as provided in § 265.1).

(b) Except as provided in § 265.1064(j), this subpart applies to equipment that contains or contacts hazardous wastes with organic concentrations of at least 10 percent by weight that are managed in:

(1) Units that are subject to the permitting requirements of part 270, or

(2) Hazardous waste recycling units that are located on hazardous waste management facilities otherwise subject to the permitting requirements of part 270.

(c) Each piece of equipment to which this subpart applies shall be marked in such a manner that it can be distinguished readily from other pieces of equipment.

(d) Equipment that is in vacuum service is excluded from the requirements of § 265.1052 to § 265.1060 if it is identified as required in § 265.1064(g)(5).

[Note: The requirements of §§ 265.1052 through 265.1064 apply to equipment associated with hazardous waste recycling units previously exempt under paragraph 261.6(c)(1). Other exemptions under §§ 261.4, 262.34, and 265.1(c) are not affected by these requirements.]

### § 265.1051 Definitions.

As used in this subpart, all terms shall have the meaning given them in § 264.1031, the Act, and parts 260–266.

### § 265.1052 Standards: Pumps in light liquid service.

(a)(1) Each pump in light liquid service shall be monitored monthly to detect leaks by the methods specified in § 265.1063(b), except as provided in paragraphs (d), (e), and (f) of this section.

(2) Each pump in light liquid service shall be checked by visual inspection each calendar week for indications of liquids dripping from the pump seal.

(b)(1) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(2) If there are indications of liquids dripping from the pump seal, a leak is detected.

(c)(1) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 265.1059.

(2) A first attempt at repair (e.g., tightening the packing gland) shall be made no later than 5 calendar days after each leak is detected.

(d) Each pump equipped with a dual mechanical seal system that includes a barrier fluid system is exempt from the requirements of paragraph (a), *provided* the following requirements are met:

(1) Each dual mechanical seal system must be:

(i) Operated with the barrier fluid at a pressure that is at all times greater than the pump stuffing box pressure, or

(ii) Equipped with a barrier fluid degassing reservoir that is connected by a closed-vent system to a control device that complies with the requirements of § 265.1060, or

(iii) Equipped with a system that purges the barrier fluid into a hazardous waste stream with no detectable emissions to the atmosphere.

(2) The barrier fluid system must not be a hazardous waste with organic concentrations 10 percent or greater by weight.

(3) Each barrier fluid system must be equipped with a sensor that will detect failure of the seal system, the barrier fluid system or both.

(4) Each pump must be checked by visual inspection, each calendar week, for indications of liquids dripping from the pump seals.

(5)(i) Each sensor as described in paragraph (d)(3) of this section must be checked daily or be equipped with an audible alarm that must be checked monthly to ensure that it is functioning properly.

(ii) The owner or operator must determine, based on design considerations and operating experience, a criterion that indicates failure of the seal system, the barrier fluid system, or both.

(6)(i) If there are indications of liquids dripping from the pump seal or the sensor indicates failure of the seal system, the barrier fluid system, or both based on the criterion determined in paragraph (d)(5)(ii) of this section, a leak is detected.

(ii) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 265.1059.

(iii) A first attempt at repair (e.g., relapping the seal) shall be made no later than 5 calendar days after each leak is detected.

(e) Any pump that is designated, as described in § 265.1064(g)(2), for no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, is exempt from the requirements of paragraphs (a), (c), and (d) of this section if the pump meets the following requirements:

(1) Must have no externally actuated shaft penetrating the pump housing.

(2) Must operate with no detectable emissions as indicated by an instrument reading of less than 500 ppm above background as measured by the methods specified in § 265.1063(c).

(3) Must be tested for compliance with paragraph (a)(2) of this section initially upon designation, annually, and at other times as requested by the Regional Administrator.

(f) If any pump is equipped with a closed-vent system capable of capturing and transporting any leakage from the seal or seals to a control device that complies with the requirements of § 265.1060, it is exempt from the requirements of paragraphs (a) through (e) of this section.

### § 265.1053 Standards: Compressors.

(a) Each compressor shall be equipped with a seal system that includes a barrier fluid system and that prevents leakage of total organic emissions to the atmosphere, except as provided in paragraphs (h) and (i) of this section.

(b) Each compressor seal system as required in paragraph (a) of this section shall be:

(1) Operated with the barrier fluid at a pressure that is at all times greater than the compressor stuffing box pressure, or

(2) Equipped with a barrier fluid system that is connected by a closed-vent system to a control device that complies with the requirements of § 265.1060, or

(3) Equipped with a system that purges the barrier fluid into a hazardous waste stream with no detectable emissions to atmosphere.

(c) The barrier fluid must not be a hazardous waste with organic concentrations 10 percent or greater by weight.

(d) Each barrier fluid system as described in paragraphs (a) through (c) of this section shall be equipped with a sensor that will detect failure of the seal system, barrier fluid system, or both.

(e)(1) Each sensor as required in paragraph (d) of this section shall be checked daily or shall be equipped with an audible alarm that must be checked monthly to ensure that it is functioning properly unless the compressor is located within the boundary of an unmanned plant site, in which case the sensor must be checked daily.

(2) The owner or operator shall determine, based on design considerations and operating experience, a criterion that indicates

failure of the seal system, the barrier fluid system or both.

(f) If the sensor indicates failure of the seal system, the barrier fluid system, or both based on the criterion determined under paragraph (e)(2) of this section, a leak is detected.

(g)(1) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 265.1059.

(2) A first attempt at repair (e.g., tightening the packing gland) shall be made no later than 5 calendar days after each leak is detected.

(h) A compressor is exempt from the requirements of paragraphs (a) and (b) of this section if it is equipped with a closed-vent system capable of capturing and transporting any leakage from the seal to a control device that complies with the requirements of § 265.1060, except as provided in paragraph (i) of this section.

(i) Any compressor that is designated, as described in § 265.1064(g)(2), for no detectable emission as indicated by an instrument reading of less than 500 ppm above background is exempt from the requirements of paragraphs (a) through (h) of this section if the compressor:

(1) Is determined to be operating with no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as measured by the method specified in § 265.1063(c).

(2) Is tested for compliance with paragraph (i)(1) of this section initially upon designation, annually, and at other times as requested by the Regional Administrator.

### § 265.1054 Standards: Pressure relief devices in gas/vapor service.

(a) Except during pressure releases, each pressure relief device in gas/vapor service shall be operated with no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as measured by the method specified in § 265.1063(c).

(b)(1) After each pressure release, the pressure relief device shall be returned to a condition of no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as soon as practicable, but no later than 5 calendar days after each pressure release, except as provided in § 265.1059.

(2) No later than 5 calendar days after the pressure release, the pressure relief device shall be monitored to confirm the condition of no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, as measured by the method specified in § 265.1063(c).

(c) Any pressure relief device that is equipped with a closed-vent system capable of capturing and transporting leakage from the pressure relief device to a control device as described in § 265.1060 is exempt from the requirements of paragraphs (a) and (b) of this section.

### § 265.1055 Standards: Sampling connecting systems.

(a) Each sampling connection system shall be equipped with a closed-purge system or closed-vent system.

(b) Each closed-purge system or closed-vent system as required in paragraph (a) shall:

(1) Return the purged hazardous waste stream directly to the hazardous waste management process line with no detectable emissions to atmosphere, or

(2) Collect and recycle the purged hazardous waste stream with no detectable emissions to atmosphere, or

(3) Be designed and operated to capture and transport all the purged hazardous waste stream to a control device that complies with the requirements of § 265.1060.

(c) *In situ* sampling systems are exempt from the requirements of paragraphs (a) and (b) of this section.

### § 265.1056 Standards: Open-ended valves or lines.

(a)(1) Each open-ended valve or line shall be equipped with a cap, blind flange, plug, or a second valve.

(2) The cap, blind flange, plug, or second valve shall seal the open end at all times except during operations requiring hazardous waste stream flow through the open-ended valve or line.

(b) Each open-ended valve or line equipped with a second valve shall be operated in a manner such that the valve on the hazardous waste stream end is closed before the second valve is closed.

(c) When a double block and bleed system is being used, the bleed valve or line may remain open during operations that require venting the line between the block valves but shall comply with paragraph (a) of this section at all other times.

### § 265.1057 Standards: Valves in gas/vapor service or in light liquid service.

(a) Each valve in gas/vapor or light liquid service shall be monitored monthly to detect leaks by the methods specified in § 265.1063(b) and shall comply with paragraphs (b) through (e) of this section, except as provided in paragraphs (f), (g), and (h) of this section' and §§ 265.1061 and 265.1062.

(b) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(c)(1) Any valve for which a leak is not detected for two successive months may be monitored the first month of every succeeding quarter, beginning with the next quarter, until a leak is detected.

(2) If a leak is detected, the valve shall be monitored monthly until a leak is not detected for 2 successive months.

(d)(1) When a leak is detected, it shall be repaired as soon as practicable, but no later than 15 calendar days after the leak is detected, except as provided in § 265.1059.

(2) A first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

(e) First attempts at repair include, but are not limited to, the following best practices where practicable:

(1) Tightening of bonnet bolts.

(2) Replacement of bonnet bolts.

(3) Tightening of packing gland nuts.

(4) Injection of lubricant into lubricated packing.

(f) Any valve that is designated, as described in § 265.1064(g)(2), for no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, is exempt from the requirements of paragraph (a) of this section if the valve:

(1) Has no external actuating mechanism in contact with the hazardous waste stream.

(2) Is operated with emissions less than 500 ppm above background as determined by the method specified in § 265.1063(c).

(3) Is tested for compliance with paragraph (f)(2) of this section initially upon designation, annually, and at other times as requested by the Regional Administrator.

(g) Any valve that is designated, as described in § 265.1064(h)(1), as an unsafe-to-monitor valve is exempt from the requirements of paragraph (a) of this section if:

(1) The owner or operator of the valve determines that the valve is unsafe to monitor because monitoring personnel would be exposed to an immediate danger as a consequence of complying with paragraph (a) of this section.

(2) The owner or operator of the valve adheres to a written plan that requires monitoring of the valve as frequently as practicable during safe-to-monitor times.

(h) Any valve that is designated, as described in § 265.1064(h)(2), as a difficult-to-monitor valve is exempt from the requirements of paragraph (a) of this section if:

(1) The owner or operator of the valve determines that the valve cannot be monitored without elevating the

monitoring personnel more than 2 meters above a support surface.

(2) The hazardous waste management unit within which the valve is located was in operation before June 21, 1990.

(3) The owner or operator of the valve follows a written plan that requires monitoring of the valve at least once per calendar year.

### § 265.1058 Standards: Pumps and valves in heavy liquid service, pressure relief devices in light liquid or heavy liquid service, and flanges and other connectors.

(a) Pumps and valves in heavy liquid service, pressure relief devices in light liquid or heavy liquid service, and flanges and other connectors shall be monitored within 5 days by the method specified in § 265.1063(b) if evidence of a potential leak is found by visual, audible, olfactory, or any other detection method.

(b) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(c)(1) When a leak is detected, it shall be repaired as soon as practicable, but not later than 15 calendar days after it is detected, except as provided in § 265.1059.

(2) The first attempt at repair shall be made no later than 5 calendar days after each leak is detected.

(d) First attempts at repair include, but are not limited to, the best practices described under § 265.1057(e).

### § 265.1059 Standards: Delay of repair.

(a) Delay of repair of equipment for which leaks have been detected will be allowed if the repair is technically infeasible without a hazardous waste management unit shutdown. In such a case, repair of this equipment shall occur before the end of the next hazardous waste management unit shutdown.

(b) Delay of repair of equipment for which leaks have been detected will be allowed for equipment that is isolated from the hazardous waste management unit and that does not continue to contain or contact hazardous waste with organic concentrations at least 10 percent by weight.

(c) Delay of repair for valves will be allowed if:

(1) The owner or operator determines that emissions of purged material resulting from immediate repair are greater then the emissions likely to result from delay of repair.

(2) When repair procedures are effected, the purged material is collected and destroyed or recovered in a control device complying with § 285.1060.

(d) Delay of repair for pumps will be allowed if:

(1) Repair requires the use of a dual mechanical seal system that includes a barrier fluid system.

(2) Repair is completed as soon as practicable, but not later than 6 months after the leak was detected.

(e) Delay of repair beyond a hazardous waste management unit shutdown will be allowed for a valve if valve assembly replacement is necessary during the hazardous waste management unit shutdown, valve assembly supplies have been depleted, and valve assembly supplies had been sufficiently stocked before the supplies were depleted. Delay of repair beyond the next hazardous waste management unit shutdown will not be allowed unless the next hazardous waste management unit shutdown occurs sooner than 6 months after the first hazardous waste management unit shutdown.

### § 265.1060 Standards: Closed-vent systems and control devices.

Owners or operators of closed-vent systems and control devices shall comply with the provisions of § 265.1033.

### § 265.1061 Alternative standards for valves in gas/vapor service or in light liquid service: percentage of valves allowed to leak.

(a) An owner or operator subject to the requirements of § 265.1057 may elect to have all valves within a hazardous waste management unit comply with an alternative standard which allows no greater than 2 percent of the valves to leak.

(b) The following requirements shall be met if an owner or operator decides to comply with the alternative standard of allowing 2 percent of valves to leak:

(1) An owner or operator must notify the Regional Administrator that the owner or operator has elected to comply with the requirements of this section.

(2) A performance test as specified in paragraph (c) of this section shall be conducted initially upon designation, annually, and at other times requested by the Regional Administrator.

(3) If a valve leak is detected, it shall be repaired in accordance with § 265.1057 (d) and (e).

(c) Performance tests shall be conducted in the following manner:

(1) All valves subject to the requirements in § 265.1057 within the hazardous waste management unit shall be monitored within 1 week by the methods specified in § 265.1063(b).

(2) If an instrument reading of 10,000 ppm or greater is measured, a leak is detected.

(3) The leak percentage shall be determined by dividing the number of valves subject to the requirements in § 265.1057 for which leaks are detected by the total number of valves subject to the requirements in § 265.1057 within the hazardous waste management unit.

(d) If an owner or operator decides no longer to comply with this section, the owner or operator must notify the Regional Administrator in writing that the work practice standard described in § 265.1057 (a) through (e) will be followed.

### § 265.1062 Alternative standards for valves in gas/vapor service or in light liquid service: skip period leak detection and repair.

(a)(1) An owner or operator subject to the requirements of § 265.1057 may elect for all valves within a hazardous waste management unit to comply with one of the alternative work practices specified in paragraphs (b) (2) and (3) of this section.

(2) An owner or operator must notify the Regional Administrator before implementing one of the alternative work practices.

(b)(1) An owner or operator shall comply with the requirements for valves, as described in § 265.1057, except as described in paragraphs (b)(2) and (b)(3) of this section.

(2) After two consecutive quarterly leak detection periods with the percentage of valves leaking equal to or less than 2 percent, an owner or operator may begin to skip one of the quarterly leak detection periods for the valves subject to the requirements in § 265.1057.

(3) After five consecutive quarterly leak detection periods with the percentage of valves leaking equal to or less than 2 percent, an owner or operator may begin to skip three of the quarterly leak detection periods for the valves subject to the requirements in § 265.1057.

(4) If the percentage of valves leaking is greater than 2 percent, the owner or operators hall monitor monthly in compliance with the requirements in § 265.1057, but may again elect to use this section after meeting the requirements of § 265.1057(c)(1).

### § 265.1063 Test methods and procedures.

(a) Each owner or operator subject to the provisions of this subpart shall comply with the test methods and procedures requirements provided in this section.

(b) Leak detection monitoring, as required in §§ 265.1052–285.1062, shall comply with the following requirements:

(1) Monitoring shall comply with Reference Method 21 in 40 CFR Part 60.

(2) The detection instrument shall meet the performance criteria of Reference Method 21.

(3) The instrument shall be calibrated before use on each day of its use by the procedures specified in Reference Method 21.

(4) Calibration gases shall be:

(i) Zero air (less than 10 ppm of hydrocarbon in air).

(ii) A mixture of methane or n-hexane and air at a concentration of approximately, but less than, 10,000 ppm methane or n-hexane.

(5) The instrument probe shall be traversed around all potential leak interfaces as close to the interface as possible as described in Reference Method 21.

(c) When equipment is tested for compliance with no detectable emissions, as required in §§ 265.1052(e), 265.1053(i), 265.1054, and 265.1057(f), the test shall comply with the following requirements:

(1) The requirements of paragraphs (b)(1) through (4) of this section shall apply.

(2) The background level shall be determined, as set forth in Reference Method 21.

(3) The instrument probe shall be traversed around all potential leak interfaces as close to the interface as possible as described in Reference Method 21.

(4) The arithmetic difference between the maximum concentration indicated by the instrument and the background level is compared with 500 ppm for determining compliance.

(d) In accordance with the waste analysis plan required by § 265.13(b), an owner or operator of a facility must determine, for each piece of equipment, whether the equipment contains or contacts a hazardous waste with organic concentration that equals or exceeds 10 percent by weight using the following:

(1) Methods described in ASTM Methods D 2267–88, E 169–87, E 168–88, E 260–85 (incorporated by reference under § 260.11);

(2) Method 9060 or 8240 of SW–846 (incorporated by reference under § 260.11); or

(3) Application of the knowledge of the nature of the hazardous waste stream or the process by which it was produced. Documentation of a waste determination by knowledge is required. Examples of documentation that shall be used to support a determination under this provision include production process information documenting that no organic compounds are used, information that the waste is generated by a process that is identical to a process at the same or another facility that has previously been demonstrated by direct measurement to have a total organic content less than 10 percent, or prior speciation analysis results on the same waste stream where it can also be documented that no process changes have occurred since that analysis that could affect the waste total organic concentration.

(e) If an owner or operator determines that a piece of equipment contains or contacts a hazardous waste with organic concentrations at least 10 percent by weight, the determination can be revised only after following the procedures in paragraph (d)(1) or (d)(2) of this section.

(f) When an owner or operator and the Regional Administrator do not agree on whether a piece of equipment contains or contacts a hazardous waste with organic concentrations at least 10 percent by weight, the procedures in paragraph (d)(1) or (d)(2) of this section can be used to resolve the dispute.

(g) Samples used in determining the percent organic content shall be representative of the highest total organic content hazardous waste that is expected to be contained in or contact the equipment.

(h) To determine if pumps or valves are in light liquid service, the vapor pressures of constituents may be obtained from standard reference texts or may be determined by ASTM D–2879–86 (incorporated by reference under § 260.11).

(i) Performance tests to determine if a control device achieves 95 weight percent organic emission reduction shall comply with the procedures of § 265.1034 (c)(1) through (c)(4).

### § 265.1064 Recordkeeping requirements.

(a)(1) Each owner or operator subject to the provisions of this subpart shall comply with the recordkeeping requirements of this section.

(2) An owner or operator of more than one hazardous waste management unit subject to the provisions of this subpart may comply with the recordkeeping requirements for these hazardous waste management units in one recordkeeping system if the system identifies each record by each hazardous waste management unit.

(b) Owners and operators must record the following information in the facility operating record:

(1) For each piece of equipment to which subpart BB of part 265 applies:

(i) Equipment identification number and hazardous waste management unit identification.

(ii) Approximate locations within the facility (e.g., identify the hazardous waste management unit on a facility plot plan).

(iii) Type of equipment (e.g., a pump or pipeline valve).

(iv) Percent-by-weight total organics in the hazardous waste stream at the equipment.

(v) Hazardous waste state at the equipment (e.g., gas/vapor or liquid).

(vi) Method of compliance with the standard (e.g., "monthly leak detection and repair" or "equipped with dual mechanical seals").

(2) For facilities that comply with the provisions of § 265.1033(a)(2), an implementation schedule as specified in § 265.1033(a)(2).

(3) Where an owner or operator chooses to use test data to demonstrate the organic removal efficiency or total organic compound concentration achieved by the control device, a performance test plan as specified in § 265.1035(b)(3).

(4) Documentation of compliance with § 265.1060, including the detailed design documentation or performance test results specified in § 265.1035(b)(4).

(c) When each leak is detected as specified in §§ 265.1052, 265.1953, 265.1057, and 265.1058, the following requirements apply:

(1) A weatherproof and readily visible identification, marked with the equipment identification number, the date evidence of a potential leak was found in accordance with § 265.1058(a), and the date the leak was detected, shall be attached to the leaking equipment.

(2) The identification on equipment, except on a valve, may be removed after it has been repaired.

(3) The identification on a valve may be removed after it has been monitored for 2 successive months as specified in § 265.1057(c) and no leak has been detected during those 2 months.

(d) When each leak is detected as specified in §§ 265.1052, 265.1053, 265.1057, and 265.1058, the following information shall be recorded in an inspection log and shall be kept in the facility operating record:

(1) The instrument and operator identification numbers and the equipment identification number.

(2) The date evidence of a potential leak was found in accordance with § 265.1058(a).

(3) The date the leak was detected and the dates of each attempt to repair the leak.

(4) Repair methods applied in each attempt to repair the leak.

(5) "Above 10,000" if the maximum instrument reading measured by the methods specified in § 265.1063(b) after

each repair attempt is equal to or greater than 10,000 ppm.

(6) "Repair delayed" and the reason for the delay if a leak is not repaired within 15 calendar days after discovery of the leak.

(7) Documentation supporting the delay of repair of a valve in compliance with § 265.1059(c).

(8) The signature of the owner or operator (or designate) whose decision it was that repair could not be effected without a hazardous waste management unit shutdown.

(9) The expected date of successful repair of the leak if a leak is not repaired within 15 calendar days.

(10) The date of successful repair of the leak.

(e) Design documentation and monitoring, operating, and inspection information for each closed-vent system and control device required to comply with the provisions of § 265.1060 shall be recorded and kept up-to-date in the facility operating record as specified in § 265.1035(c). Design documentation is specified in § 265.1035 (c)(1) and (c)(2) and monitoring, operating, and inspection information in § 265.1035 (c)(3)–(c)(8).

(f) For a control device other than a thermal vapor incinerator, catalytic vapor incinerator, flare, boiler, process heater, condenser, or carbon adsorption system, monitoring and inspection information indicating proper operation and maintenance of the control device must be recorded in the facility operating record.

(g) The following information pertaining to all equipment subject to the requirements in §§ 265.1052 through 265.1060 shall be recorded in a log that is kept in the facility operating record:

(1) A list of identification numbers for equipment (except welded fittings) subject to the requirements of this subpart.

(2)(i) A list of identification numbers for equipment that the owner or operator elects to designate for no detectable emissions, as indicated by an instrument reading of less than 500 ppm above background, under the provisions of §§ 265.1052(e), 265.1053(i), and 265.1057(f).

(ii) The designation of this equipment as subject to the requirements of §§ 265.1052(e), 265.1053(i), or 265.1057(f) shall be signed by the owner or operator.

(3) A list of equipment identification numbers for pressure relief devices required to comply with § 265.1054(a).

(4)(i) The dates of each compliance test required in §§ 265.1052(e), 265.1053(i), 265.1054, and 265.1057(f).

(ii) The background level measured during each compliance test.

(iii) The maximum instrument reading measured at the equipment during each compliance test.

(5) A list of identification numbers for equipment in vacuum service.

(h) The following information pertaining to all valves subject to the requirements of § 265.1057 (g) and (h) shall be recorded in a log that is kept in the facility operating record:

(1) A list of identification numbers for valves that are designated as unsafe to monitor, an explanation for each valve stating why the valve is unsafe to monitor, and the plan for monitoring each valve.

(2) A list of identification numbers for valves that are designated as difficult to monitor, an explanation for each valve stating why the valve is difficult to monitor, and the planned schedule for monitoring each valve.

(i) The following information shall be recorded in the facility operating record for valves complying with § 265.1062:

(1) A schedule of monitoring.

(2) The percent of valves found leaking during each monitoring period.

(j) The following information shall be recorded in a log that is kept in the facility operating record:

(1) Criteria required in §§ 265.1052(d)(5)(ii) and 265.1053(e)(2) and an explanation of the criteria.

(2) Any changes to these criteria and the reasons for the changes.

(k) The following information shall be recorded in a log that is kept in the facility operating record for use in determining exemptions as provided in the applicability section of this subpart and other specific subparts:

(1) An analysis determining the design capacity of the hazardous waste management unit.

(2) A statement listing the hazardous waste influent to and effluent from each hazardous waste management unit subject to the requirements in §§ 265.1052 through 265.1060 and an analysis determining whether these hazardous wastes are heavy liquids.

(3) An up-to-date analysis and the supporting information and data used to determine whether or not equipment is subject to the requirements in §§ 265.1052 through 265.1060. The record shall include supporting documentation as required by § 265.1063(d)(3) when application of the knowledge of the nature of the hazardous waste stream or the process by which it was produced is used. If the owner or operator takes any action (e.g., changing the process that produced the waste) that could result in an increase in the total organic content of the waste contained in or contacted by equipment determined not to be subject to the requirements in §§ 265.1052 through 265.1060, then a new determination is required.

(l) Records of the equipment leak information required by paragraph (d) of this section and the operating information required by paragraph (e) of this section need be kept only 3 years.

(m) The owner or operator of any facility that is subject to this subpart and to regulations at 40 CFR part 60, subpart VV, or 40 CFR part 61, subpart V, may elect to determine compliance with this subpart by documentation either pursuant to § 265.1064 of this subpart, or pursuant to those provisions of 40 CFR part 60 or 61, to the extent that the documentation under the regulation at 40 CFR part 60 or part 61 duplicates the documentation required under this subpart. The documentation under the regulation at 40 CFR part 60 or part 61 shall be kept with or made readily available with the facility operating record.

(Approved by the Office of Management and Budget under control number 2060-0195)

### §§ 265.1065–265.1079 [Reserved]

## PART 270—EPA-ADMINISTERED PERMIT PROGRAMS: THE HAZARDOUS WASTE PERMIT PROGRAM

19. The authority citation for part 270 continues to read as follows:

Authority: 42 U.S.C. 6905, 6912, 6921–6927, 6930, 6934, 6935, 6937–6939, and 6974.

### Subpart B—Permit Application

20. Section 270.14 is amended by revising the last sentence of paragraph (b)(5) and by revising paragraphs (b)(8) (iv), (v), and by adding paragraph (b)(8)(vi) to read as follows:

### § 270.14 Contents of Part B: General requirements

* * * * *

(b) * * *

(5) * * * Include, where applicable, as part of the inspection schedule, specific requirements in §§ 264.174, 264.193(i), 264.195, 264.226, 264.254, 264.273, 264.303, 264.602, 264.1033, 264.1052, 264.1053, and 264.1058.

* * * * *

(8) * * *

(iv) Mitigate effects of equipment failure and power outages;

(v) Prevent undue exposure of personnel to hazardous waste (for example, protective clothing); and

(vi) Prevent releases to atmosphere.

* * * * *

Section 270.24 is added to read as follows:

### § 270.24 Specific Part B information requirements for process vents.

Except as otherwise provided in § 264.1, owners and operators of facilities that have process vents to which subpart AA of part 264 applies must provide the following additional information:

(a) For facilities that cannot install a closed-vent system and control device to comply with the provisions of 40 CFR 264 subpart AA on the effective date that the facility becomes subject to the provisions of 40 CFR 264 or 265 subpart AA, an implementation schedule as specified in § 264.1033(a)(2).

(b) Documentation of compliance with the process vent standards in § 264.1032, including:

(1) Information and data identifying all affected process vents, annual throughput and operating hours of each affected unit, estimated emission rates for each affected vent and for the overall facility (i.e., the total emissions for all affected vents at the facility), and the approximate location within the facility of each affected unit (e.g., identify the hazardous waste management units on a facility plot plan).

(2) Information and data supporting estimates of vent emissions and emission reduction achieved by add-on control devices based on engineering calculations or source tests. For the purpose of determining compliance, estimates of vent emissions and emission reductions must be made using operating parameter values (e.g., temperatures, flow rates, or concentrations) that represent the conditions that exist when the waste management unit is operating at the highest load or capacity level reasonably expected to occur.

(3) Information and data used to determine whether or not a process vent is subject to the requirements of § 264.1032.

(c) Where an owner or operator applies for permission to use a control device other than a thermal vapor incinerator, catalytic vapor incinerator, flare, boiler, process heater, condenser, or carbon adsorption system to comply with the requirements of § 264.1032, and chooses to use test data to determine the organic removal efficiency or the total organic compound concentration achieved by the control device, a performance test plan as specified in § 264.1035(b)(3).

(d) Documentation of compliance with § 264.1033, including:

(1) A list of all information references and sources used in preparing the documentation.

(2) Records including the dates of each compliance test required by § 264.103(k).

(3) A design analysis, specifications, drawings, schematics, and piping and instrumentation diagrams based on the appropriate sections of "APTI Course 415: Control of Gaseous Emissions" (incorporated by reference as specified in § 260.11) or other engineering texts acceptable to the Regional Administrator that present basic control device design information. The design analysis shall address the vent stream characteristics and control device operation parameters as specified in § 264.1035(b)(4)(iii).

(4) A statement signed and dated by the owner or operator certifying that the operating parameters used in the design analysis reasonably represent the conditions that exist when the hazardous waste management unit is or would be operating at the highest load or capacity level reasonably expected to occur.

(5) A statement signed and dated by the owner or operator certifying that the control device is designed to operate at an efficiency of 95 weight percent or greater unless the total organic emission limits of § 264.1032(a) for affected process vents at the facility can be attained by a control device involving vapor recovery at an efficiency less than 95 weight percent.

(Approved by the Office of Management and Budget under control number 2060-0195)

22. Section 270.25 is added as follows:

### § 270.25 Specific part B information requirements for equipment.

Except as otherwise provided in § 264.1, owners and operators of facilities that have equipment to which subpart BB of part 264 applies must provide the following additional information:

(a) For each piece of equipment to which subpart BB of part 264 applies:

(1) Equipment identification number and hazardous waste management unit identification.

(2) Approximate locations within the facility (e.g., identify the hazardous waste management unit on a facility plot plan).

(3) Type of equipment (e.g., a pump or pipeline valve).

(4) Percent by weight total organics in the hazardous waste stream at the equipment.

(5) Hazardous waste state at the equipment (e.g., gas/vapor or liquid).

(6) Method of compliance with the standard (e.g., "monthly leak detection and repair" or "equipped with dual mechanical seals").

(b) For facilities that cannot install a closed-vent system and control device to comply with the provisions of 40 CFR 264 subpart BB on the effective date that the facility becomes subject to the provisions of 40 CFR 264 or 265 subpart BB, an implementation schedule as specified in § 264.1033(a)(2).

(c) Where an owner or operator applies for permission to use a control device other than a thermal vapor incinerator, catalytic vapor incinerator, flare, boiler, process heater, condenser, or carbon adsorption system and chooses to use test data to determine the organic removal efficiency or the total organic compound concentration achieved by the control device, a performance test plan as specified in § 264.1035(b)(3).

(d) Documentation that demonstrates compliance with the equipment standards in §§ 264.1052 to 264.1059. This documentation shall contain the records required under § 264.1064. The Regional Administrator may request further documentation before deciding if compliance has been demonstrated.

(e) Documentation to demonstrate compliance with § 264.1060 shall include the following information:

(1) A list of all information references and sources used in preparing the documentation.

(2) Records including the dates of each compliance test required by § 264.1033(j).

(3) A design analysis, specifications, drawings, schematics, and piping and instrumentation diagrams based on the appropriate sections of "ATPI Course 415: Control of Gaseous Emissions" (incorporated by reference as specified in § 260.11) or other engineering texts acceptable to the Regional Administrator that present basic control device design information. The design analysis shall address the vent stream characteristics and control device operation parameters as specified in § 264.1035(b)(4)(iii).

(4) A statement signed and dated by the owner or operator certifying that the operating parameters used in the design analysis reasonably represent the conditions that exist when the hazardous waste management unit is operating at the highest load or capacity level reasonably expected to occur.

(5) A statement signed and dated by the owner or operator certifying that the control device is designed to operate at an efficiency of 95 weight percent or greater.

(Approved by the Office of Management and Budget under control number 2060-0915)

## PART 271—REQUIREMENTS FOR AUTHORIZATION OF STATE HAZARDOUS WASTE PROGRAMS

23. The authority citation for part 271 continues to read as follows:

Authority: 42 U.S.C. 6905, 6912(a), and 6926.

## Subpart A—Requirements for Final Authorization

24. Section 271.1(j) is amended by adding the following entry to Table 1 in chronological order by date of publication:

**§ 271.1 Purpose and scope.**

* * * * *

(j) * * *

TABLE 1. REGULATIONS IMPLEMENTING THE HAZARDOUS AND SOLID WASTE AMENDMENTS OF 1984

| Promulgation date | Title of regulation | Federal Register reference | Effective date |
|---|---|---|---|
| * | * * | * | * |
| [Insert date of publication]. | Process Vent and Equipment Leak Organic Air Emission Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities. | [Insert FR reference on date of publication]. | [Insert effective date.] |

[FR Doc. 90-14260 Filed 6-20-90; 8:45 am]

BILLING CODE 6560-50-M

# APPENDIX B

# METHOD 21. DETERMINATION OF VOLATILE ORGANIC COMPOUND LEAKS

# APPENDIX B

## METHOD 21. DETERMINATION OF VOLATILE ORGANIC COMPOUND LEAKS

### 1. Applicability and Principle

1.1 Applicability. This method applies to the determination of volatile organic compound (VOC) leaks from process equipment. These sources include, but are not limited to, valves, flanges and other connections, pumps and compressors, pressure relief devices, process drains, open-ended valves, pump and compressor seal system degassing vents, accumulator vessel vents, agitator seals, and access door seals.

1.2 Principle. A portable instrument is used to detect VOC leaks from individual sources. The instrument detector type is not specified, but it must meet the specifications and performance criteria contained in Section 3. A leak definition concentration based on a reference compound is specified in each applicable regulation. This procedure is intended to locate and classify leaks only, and is not to be used as a direct measure of mass emission rates from individual sources.

### 2. Definitions

2.1 Leak Definition Concentration. The local VOC concentration at the surface of a leak source that indicates that a VOC emission (leak) is present. The leak definition is an instrument meter reading based on a reference compound.

2.2 Reference Compound. The VOC species selected as an instrument calibration basis for specification of the leak definition concentration. [For example: If a leak definition concentration is 10,000 ppmv as methane, then any source emission that results in a local concentration that yields a meter reading of 10,000 on an instrument calibrated with methane would be classified as a leak. In this example, the leak definition is 10,000 ppmv, and the reference compound is methane.]

2.3 Calibration Gas. The VOC compound used to adjust the instrument meter reading to a known value. The calibration gas is usually the reference compound at a concentration approximately equal to the leak definition concentration.

2.4 No Detectable Emission. The local VOC concentration at the surface of a leak source that indicates that a VOC emission (leak) is not present. Since background VOC concentrations may exist, and to account for instrument drift and imperfect reproducibility, a difference between the source surface concentration and the local ambient concentration is determined. A difference based on meter readings of less than 5 percent of the leak definition concentration indicates that a VOC emission (leak) is not present. (For example, if the leak definition in a regulation is 10,000 ppmv, then the allowable increase in surface concentration versus local ambient concentration would be 500 ppmv based on the instrument meter readings.)

2.5 Response Factor. The ratio of the known concentration of a VOC compound to the observed meter reading when measured using an instrument calibrated with the reference compound specified in the application regulation.

2.6 Calibration Precision. The degree of agreement between measurements of the same known value, expressed as the relative percentage of the average difference between the meter readings and the known concentration to the known concentration.

2.7 Response Time. The time interval from a step change in VOC concentration at the input of the sampling system to the time at which 90 percent of the corresponding final value is reached as displayed on the instrument readout meter.

## 3.0 Apparatus

### 3.1 Monitoring Instrument.

### 3.1.1 Specifications.

a. The VOC instrument detector shall respond to the compounds being processed. Detector types which may meet this requirement include, but are not limited to, catalytic oxidation, flame ionization, infrared absorption, and photoionization.

b. The instrument shall be capable of measuring the leak definition concentration specified in the regulation.

c. The scale of the instrument meter shall be readable to ±5 percent of the specified leak definition concentration.

d. The instrument shall be equipped with a pump so that a continuous sample is provided to the detector. The nominal sample flow rate shall be 1/2 to 3 liters per minute.

e. The instrument shall be intrinsically safe for operation in explosive atmospheres as defined by the applicable U.S.A. standards (e.g., National Electrical Code by the National Fire Prevention Association).

3.1.2 Performance Criteria.

a. The instrument response factors for the individual compounds to be measured must be less than 10.

b. The instrument response time must be equal to or less than 30 seconds. The response time must be determined for the instrument configuration to be used during testing.

c. The calibration precision must be equal to or less than 10 percent of the calibration gas value.

d. The evaluation procedure for each parameter is given in Section 4.4.

3.1.3 Performance Evaluation Requirements.

a. A response factor must be determined for each compound that is to be measured, either by testing or from reference sources. The response factor tests are required before placing the analyzer into service, but do not have to be repeated at subsequent intervals.

b. The calibration precision test must be completed prior to placing the analyzer into service, and at subsequent 3-month intervals or at the next use whichever is later.

c. The response time test is required prior to placing the instrument into service. If a modification to the sample pumping system of flow configuration is made that would change the response time, a new test is required prior to further use.

3.2 Calibration Gases. The monitoring instrument is calibrated in terms of parts per million by volume (ppmv) of the reference compound specified in the applicable regulation. The calibration gases required for monitoring and instrument performance evaluation are a zero gas (air, <10 ppmv VOC) and a calibration gas in air mixture approximately equal to the leak definition specified in the regulation. If cylinder calibration gas mixtures are used, they must be analyzed and certified by the manufacturer to be within ±2 percent accuracy, and a shelf life must be specified. Cylinder standards must be either reanalyzed or replaced at the end of the specified shelf life. Alternately, calibration gases may be prepared by the user according to any accepted gaseous standards preparation procedure that will yield a mixture accurate to within ±2 percent. Prepared standards must be replaced each day of use unless it can be demonstrated that degradation does not occur during storage.

Calibrations may be performed using a compound other than the reference compound if a conversion factor is determined for that alternative compound so that the resulting meter readings during source surveys can be converted to reference compound results.

4. Procedures

4.1 Pretest Preparations. Perform the instrument evaluation procedures given in Section 4.4 if the evaluation requirements of Section 3.1.3 have not been met.

4.2 Calibration Procedures. Assemble and start up the VOC analyzer according to the manufacturer's instructions. After the appropriate warmup period and zero or internal calibration procedure, introduce the calibration gas into the instrument sample probe. Adjust the instrument meter readout to correspond to the calibration gas value. [Note: If the meter readout cannot be adjusted to the proper value, a malfunction of the analyzer is indicated and corrective actions are necessary before use.]

4.3 Individual Source Surveys.

4.3.1 Type I--Leak Definition Based on Concentration. Place the probe inlet at the surface of the component interface where leakage could occur. Move the probe along the interface periphery while observing the instrument readout. If an increased meter reading is observed, slowly sample the interface where leakage is indicated until the maximum meter reading is obtained. Leave the probe inlet at this maximum reading location for approximately two times the instrument response time. If the maximum observed meter reading is greater than the leak definition in the applicable regulation, record and report the results as specified in the regulation reporting requirements. Examples of the application of this general technique to specific equipment types are:

a. Valves--The most common source of leaks from valves is at the seal between the stem and housing. Place the probe at the interface where the stem exits the packing gland and sample the stem circumference. Also, place the probe at the interface of the packing gland take-up flange seat and sample the periphery. In addition, survey valve housings of multipart assembly at the surface of all interfaces where leaks could occur.

b. Flanges and Other Connections--For welded flanges, place the probe at the outer edge of the flange-gasket interface and sample the circumference of the flange. Sample other types of nonpermanent joints (such as threaded connections) with a similar traverse.

c. Pumps and Compressors--Conduct a circumferential traverse at the outer surface of the pump or compressor shaft and seal interface. If the source is a rotating shaft, position the probe inlet within 1 cm of the shaft seal interface for the survey. If the housing configuration prevents a complete traverse of the shaft periphery, sample all accessible portions. Sample all other joints on the pump or compressor housing where leakage could occur.

d. Pressure Relief Devices--The configuration of most pressure relief devices prevents sampling at the sealing seat interface. For those devices equipped with an enclosed extension, or horn, place the probe inlet at approximately the center of the exhaust area to the atmosphere.

e. Process Drains--For open drains, place the probe inlet at approximately the center of the area open to the atmosphere. For covered drains, place the probe at the surface of the cover interface and conduct a peripheral traverse.

f. Open-Ended Lines or Valves--Place the probe inlet at approximately the center of the opening to the atmosphere.

g. Seal System Degassing Vents and Accumulator Vents--Place the probe inlet at approximately the center of the opening to the atmosphere.

h. Access Door Seals--Place the probe inlet at the surface of the door seal interface and conduct a peripheral traverse.

4.3.2 Type II--"No Detectable Emission".

Determine the local ambient concentration around the source by moving the probe inlet randomly upwind and downwind at a distance of one to two meters from the source. If an interference exists with this determination due to a nearby emission or leak, the local ambient concentration may be determined at distances closer to the source, but in no case shall the distance be less than 25 centimeters. Then move the probe inlet to the surface of the source and conduct a survey as described in 4.3.1. If an increase greater than 5 percent of the leak definition concentration is obtained, record and report the results as specified by the regulation.

For those cases where the regulation requires a specific device installation, or that specified vents be ducted or piped to a control device, the existence of these conditions shall be visually confirmed. When the regulation also requires that no detectable emissions exist, visual observations and sampling surveys are required. Examples of this technique are:

(a) Pump or Compressor Seals--If applicable, determine the type of shaft seal. Perform a survey of the local area ambient VOC concentration and determine if detectable emissions exist as described above.

(b) Seal System Degassing Vents, Accumulator Vessel Vents, Pressure Relief Devices--If applicable, observe whether or not the applicable ducting or piping exists. Also, determine if any sources exist in the ducting or piping where emissions could occur prior to the control device. If the required ducting or piping exists and there are no sources where the emissions could be vented to the atmosphere prior to the control device, then it is presumed that no detectable emissions are present.

4.4 Instrument Evaluation Procedures. At the beginning of the instrument performance evaluation test, assemble and start up the instrument according to the manufacturer's instructions for recommended warmup period and preliminary adjustments.

4.4.1 Response Factor. Calibrate the instrument with the reference compound as specified in the applicable regulation. For each organic species that is to be measured during individual source surveys, obtain or prepare a known standard in air at a concentration of approximately 80 percent of the applicable leak definition unless limited by volatility or explosivity. In these cases, prepare a standard at 90 percent of the saturation concentration, or 70 percent of the lower explosive limit, respectively. Introduce this mixture to the analyzer and record the observed meter reading. Introduce zero air until a stable reading is obtained. Make a total of three measurements by alternating between the known mixture and zero air. Calculate the response factor for each repetition and the average response factor.

Alternatively, if response factors have been published for the compounds of interest for the instrument or detector type, the response factor determination is not required, and existing results may be referenced. Examples of published response factors for flame ionization and catalytic oxidation detectors are included in Section 5.

4.4.2 Calibration Precision. Make a total of three measurements by alternately using zero gas and the specified calibration gas. Record the meter readings. Calculate the average algebraic difference between the meter readings and the known value. Divide this average difference by the known calibration value and multiply by 100 to express the resulting calibration precision as a percentage.

4.4.3 Response Time. Introduce zero gas into the instrument sample probe. When the meter reading has stabilized, switch quickly to the specified calibration gas. Measure the time from switching to when 90 percent of the final stable reading is attained. Perform this test sequence three times and record the results. Calculate the average response time.

## 5. Bibliography

5.1 DuBose, D. A., and G. E. Harris. Response Factors of VOC Analyzers at a Meter Reading of 10,000 ppmv for Selected Organic Compounds. U.S. Environmental Protection Agency, Research Triangle Park, N.C. Publication No. EPA 600/2-81-051. September 1981.

5.2 Brown, G. E., et al. Response Factors of VOC Analyzers Calibrated with Methane for Selected Organic Compounds. U.S. Environmental Protection Agency, Research Triangle park, N.C. Publication No. EPA 600/2-81-022. May 1981.

5.3 DuBose, D. A., et al. Response of Portable VOC Analyzers to Chemical Mixtures. U.S. Environmental Protection Agency, Research Triangle Park, N.C. Publication No. EPA 600/2-81-110. September 1981.

# APPENDIX C

# EXAMPLE CONDENSER DESIGN

# APPENDIX C

# EXAMPLE CONDENSER DESIGN

This appendix shows how emissions from a condenser can be calculated for single component condensation; this same procedure can be used to provide preliminary estimates of condenser size for multicomponent situations. It should be noted, however, that the following is not a rigorous procedure for the design of condensers; the example is intended to illustrate a method to provide rough estimates for evaluation purposes.

A condenser is simply a single, equilibrium stage process (sometimes referred to as a flash) in which a vapor feed is cooled and thereby condensed. The product is a two-phase (gas-liquid) stream that, if the unit is properly designed, is at equilibrium under the operating temperature and pressure. A continuous, single-stage condenser is shown in Figure C-1 in which the notation follows that of Reference 1.

Here, $z_i$, $y_i$, and $x_i$ refer to the mole fractions of component i in the vapor feed, vapor product, and liquid product streams, respectively. H, T, and P are the enthalpy, temperature, and pressure of each stream, respectively. Practically speaking, virtually all condensers are partial in that both vapor and liquid streams are produced.

It can be shown that a single-stage condenser with a single (vapor) phase feed with C different compounds and a two-phase product stream has a total of C + 4 degree of freedom.[1] That is to say, if F, $T_F$, $P_F$, and (C - 1) values of $z_i$ are known, two additional variables are needed to completely define the system.

This appendix describes the most common case in which $P_V$ is known and a target "percent condensation" (L/F) is specified (or regulated). Given these values, all of the system variables can be calculated using the appropriate thermodynamic and stoichiometric relationships. In general,

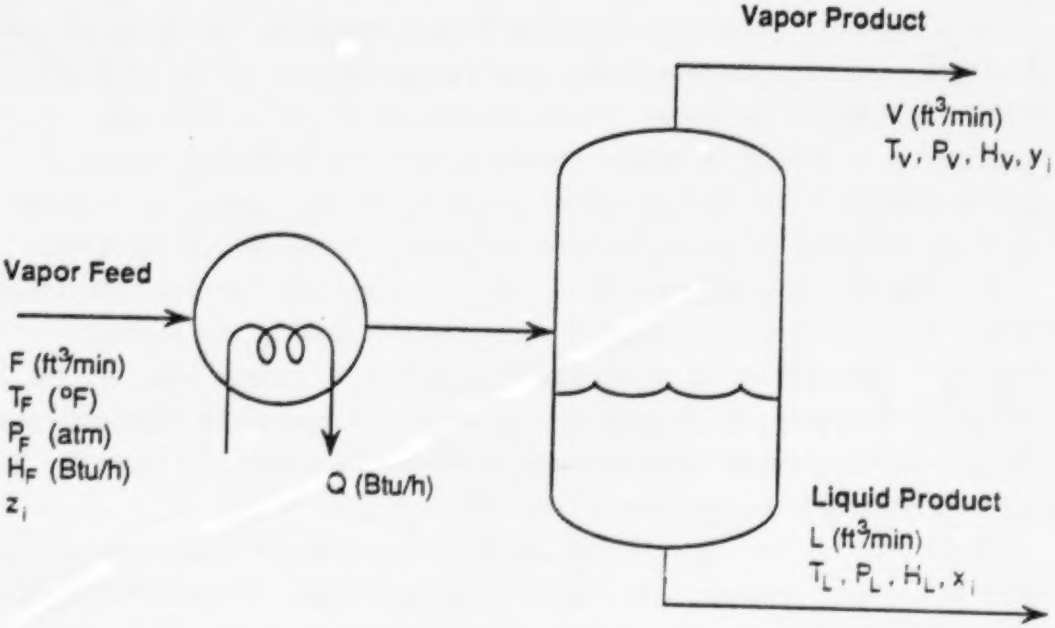

Figure C-1. Continuous, single-stage condenser.

however, the calculation procedure for determining $x_i$ and $y_i$, the equilibrium mole fractions of component i in the liquid and vapor product streams, is nontrivial for multicomponent systems. These must be known if the exit temperature, $T_V$ and $T_L$, and consequently the cooling duty (Q) in Figure C-1 are to be calculated.

As an example of the condenser design procedures, a simple, single component stream of styrene ($C_8H_8$) in air (C=2) will be considered.[2] With reference to Figure C-1, the inlet conditions are assumed to be:

$F = 2,000\ ft^3/min\ (@\ T_F)$

$Z = 1.3 \times 10^{-2}$ (13,000 ppm) styrene in air

$T_F = 90\ °F$

$P_F = 1$ atm.

Given these values, two additional parameters must be fixed to define the system. Typically, the removal efficiency (L/F) is specified to achieve a desired level of organics control. If L/F is assumed to be 0.90 for this example, the vapor stream styrene content will be reduced to 0.1 (13,000 ppm) = 1,300 ppm. The remainder of the styrene will leave the separator as liquid at the conditions of the condenser. Thus, if the condenser is operated under atmospheric conditions, the temperature of the liquid must be sufficiently low to exert a vapor pressure of (1,300/1,000,000) x 760 mmHg = 0.99 mm Torr. In other words, at 1 atm total pressure, liquid styrene is in equilibrium with 1,300 ppm of styrene vapor in air at some temperature that is unknown. Note, however, that according to the above discussion, no more variables are required to define the system. The unknown variables can be found using the appropriate thermodynamic and stoichiometric relationships.

In particular, the unknown temperature that is required for the design of the condenser is given by the styrene equilibrium vapor pressure data shown in Figure C-2. These data were taken from the CRC Handbook,[3] but they could, in general, be estimated.[4] A considerable amount of work has gone into the development of estimation techniques for pure components as well as mixtures. In any event, Figure C-2 shows that the styrene feed vapor stream must be cooled to 18 °F to condense 90 percent of the incoming vapor. The amount of condensed styrene can now be calculated:

$$\text{Amount of styrene recovered} = (0.90) \left[\frac{2{,}000\ \text{ft}^3}{\text{min}}\right] \left[\frac{\text{lb-mole gas}}{402\ \text{ft}^3}\right] \left[\frac{13{,}000 \times 10^{-6}\ \text{lb-mole styrene}}{\text{lb-mole gas}}\right]$$

$$\times \left[\frac{104\ \text{lb styrene}}{\text{lb-mole styrene}}\right] \left[\frac{60\ \text{min}}{\text{h}}\right] \qquad \text{(C-1)}$$

$$= 363\ \text{lb styrene/h}\quad .$$

Here, the "gas" is assumed to be pure air (i.e., the styrene component in the waste gas is ignored in the calculation of the physical properties of the stream).

It is now possible to estimate the cooling load on the heat exhanger, Q, in Figure C-1. The heat exchanger must provide sufficient cooling to bring the entire gas mixture from 90 °F to 18 °F (sensible heat) and to condense 364 lb styrene/h (heat of condensation). The sensible heat can be calculated using properties for air at 54 °F:

$$\text{Sensible heat} = [144.4\ \text{lb gas/min}] \left[\frac{0.248\ \text{Btu}}{\text{lb °F}}\right] [90\ \text{°F} - 18\ \text{°F}]\ [60\ \text{min/h}]$$

$$= 154{,}700\ \text{Btu/h}\quad . \qquad \text{(C-2)}$$

To this must be added the heat of condensation of 90 percent of the inlet concentration of styrene:

$$\text{Heat of condensation} = \left[\frac{167\ \text{Btu}}{\text{lb styrene}}\right] \left[\frac{364\ \text{lb styrene}}{\text{h}}\right]$$

$$= 60{,}788\ \text{Btu/h}\quad . \qquad \text{(C-3)}$$

The sum of these two is the cooling load;

$$Q = 154{,}700\ \text{Btu/h} + 60{,}788\ \text{Btu/h}$$

$$= 215{,}448\ \text{Btu/h}\quad . \qquad \text{(C-4)}$$

It should be noted that the coolant for this condenser must be at a temperature below 18 °F to effect the desired condensation. This will ordinarily require a refrigeration unit. Typically, brine solution is used as the coolant that can be cooled to 5 °F. The coolant enters the heat exchangers at 5 °F and leaves at some temperature between 5 °F and 90 °F

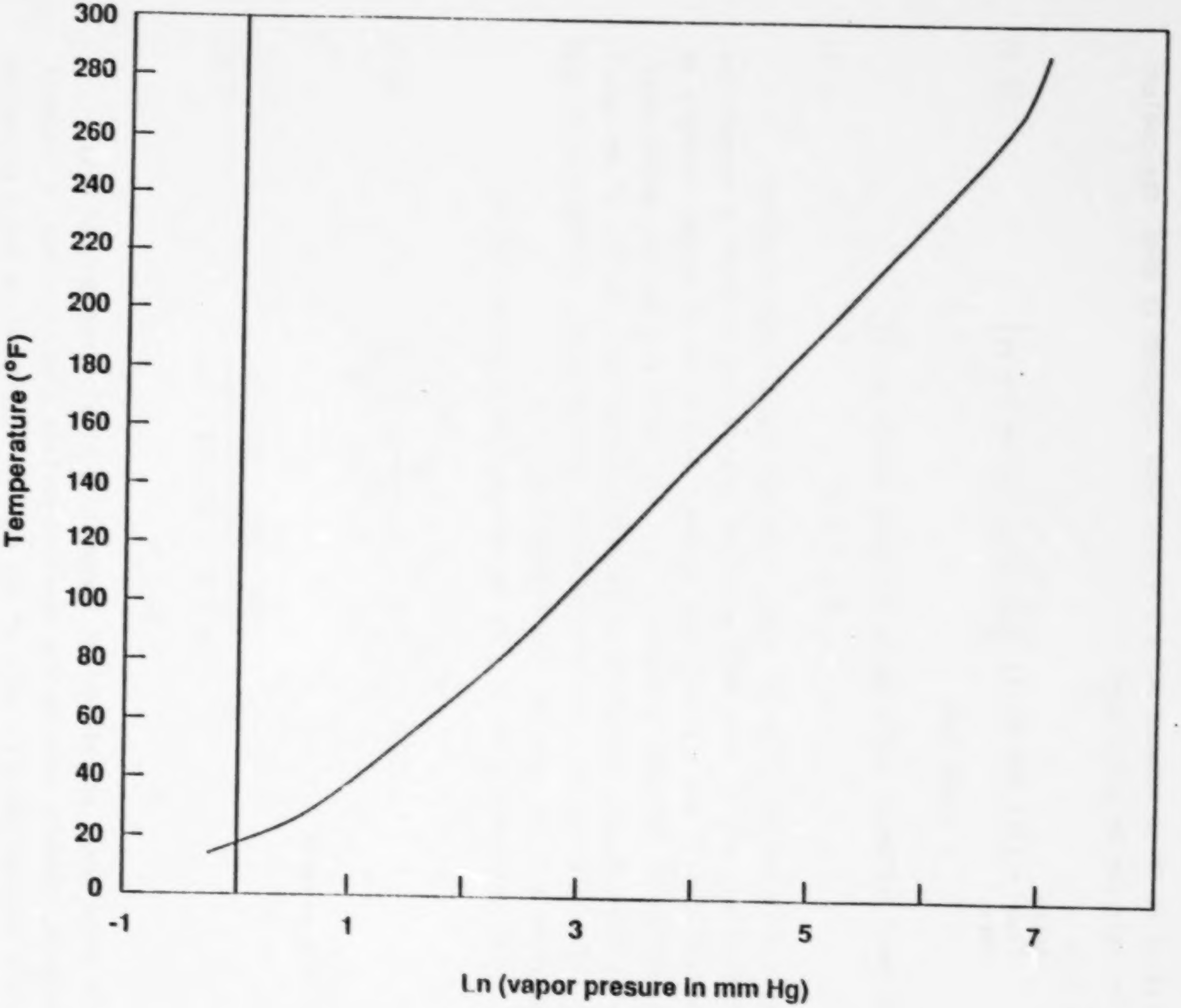

Figure C-2. Styrene equilibrium vapor pressure data.

(the inlet gas temperature). The higher this exit temperature is, the lower the coolant flow rate needs to be. The refrigeration unit, however, may limit this temperature for efficient operation. If a coolant temperature rise of 25 °F is assumed and a 2.4 mol% NaCl solution is used, the coolant flow rate can be calculated:

$$\begin{array}{l}\text{Brine} \\ \text{flow} \\ \text{rate}\end{array} = [215{,}488\ \text{Btu/h}] \left[\frac{\text{lb }°\text{F}}{0.91\ \text{Btu}}\right] \left[\frac{1}{30\ °\text{F} - 5\ °\text{F}}\right] \qquad \text{(C-5)}$$

$$= 9{,}472\ \text{lb/h} \quad .$$

The heat exchanger could now be designed according to;

$$Q = A\ U\ \Delta T \quad , \qquad \text{(C-6)}$$

where A is the heat transfer area, U is the overall heat transfer coefficient, and ΔT is a representative temperature differenece between the coolant (brine) and the waste gas stream. Both U and ΔT depend strongly on the design of the heat exchanger (i.e., whether a single-pass, double-pass, split flow, etc.). Extensive correlations exist for a variety of designs.[5] To illustrate the calculation procedures, a single-pass, countercurrent heat exchanger will be examined (see Figure C-3).

For this configuration, the appropriate ΔT relationship[6] is:

$$\Delta T = \frac{(T_{g2} - T_{c2}) - (T_{g1} - T_{c1})}{\ln [(T_{g2} - T_{c2})/(T_{g1} - T_{c1})]} \quad . \qquad \text{(C-7)}$$

In this example:

$$\Delta T = \frac{(90 - 30) - (18 - 5)}{\ln [(90 - 30)/(18 - 5)]} \qquad \text{(C-8)}$$

$$= 30.7\ °\text{F} \quad .$$

This shows that, as the coolant temperature rise is reduced, ΔT will increase, thereby reducing the required surface area, A. Thus, a tradeoff exists between the efficiency of the coolant refrigeration and A as coolant temperature rise through the heat exchanger is varied.

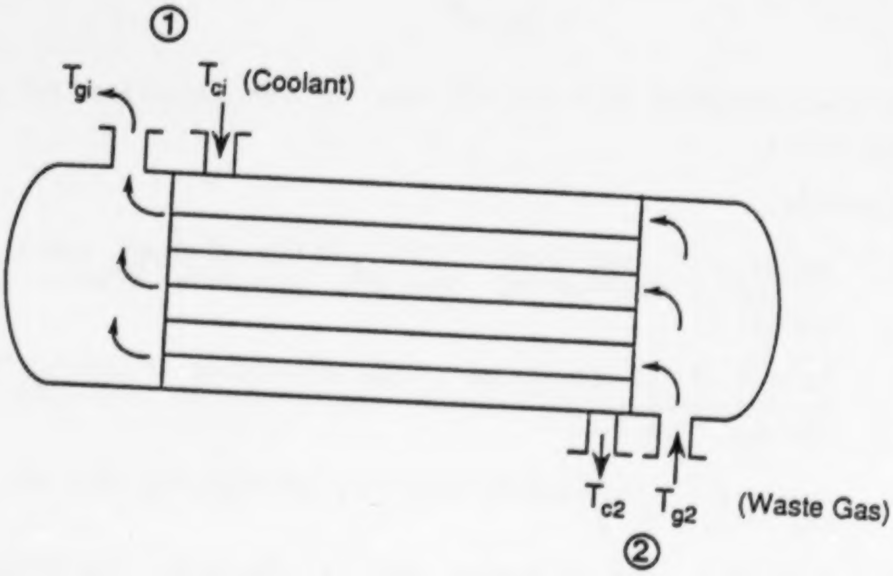

Figure C-3. Single-pass, countercurrent heat exchanger.

Perry et al.[5] gives as an overall heat transfer coefficient, U, for a gas/brine system, a value of 40 Btu/(°F•ft$^2$•h). Equation C-3 can now be used to calculate the required heat transfer area;

$$A = \left[\frac{215{,}448\ \text{Btu}}{\text{h}}\right]\left[\frac{°\text{F}\cdot\text{ft}^2\cdot\text{h}}{40\ \text{Btu}}\right]\left[\frac{1}{30.7\ °\text{F}}\right] \tag{C-9}$$

$$= 175\ \text{ft}^2\ .$$

All the parameters in Figure C-1 have now been calculated and are shown in Figure C-4.

REFERENCES

1. Henley, E.J., and Seader, J.D. Equilibrium-Stage Separation Operations in Chemical Engineering. New York, John Wiley & Sons. 1981. Chapter 7.

2. Purcell, R.Y., and Shareef, G.S. Evaluation of Control Technologies for Hazardous Air Pollutants. Publication No. EPA - 600/7-86-009a,b. February 1986.

3. Weast, R.C. Handbook of Chemistry and Physics, 56th ed., Cleveland, CRC Press. 1975.

4. Reid, R.C., J.M. Prausmitz, and T.K. Sherwood. The Properties of Gases and Liquids, 3rd ed. New York, McGraw-Hill. 1977.

5. Perry, R.H., and C.H. Chilton. Chemical Engineer's Handbook, 5th ed. New York, McGraw-Hill. 1973.

6. Bennett, C.O., and J.E. Myers. Momentum, Heat and Mass Transfer, 2nd ed. New York, McGraw-Hill. 1974.

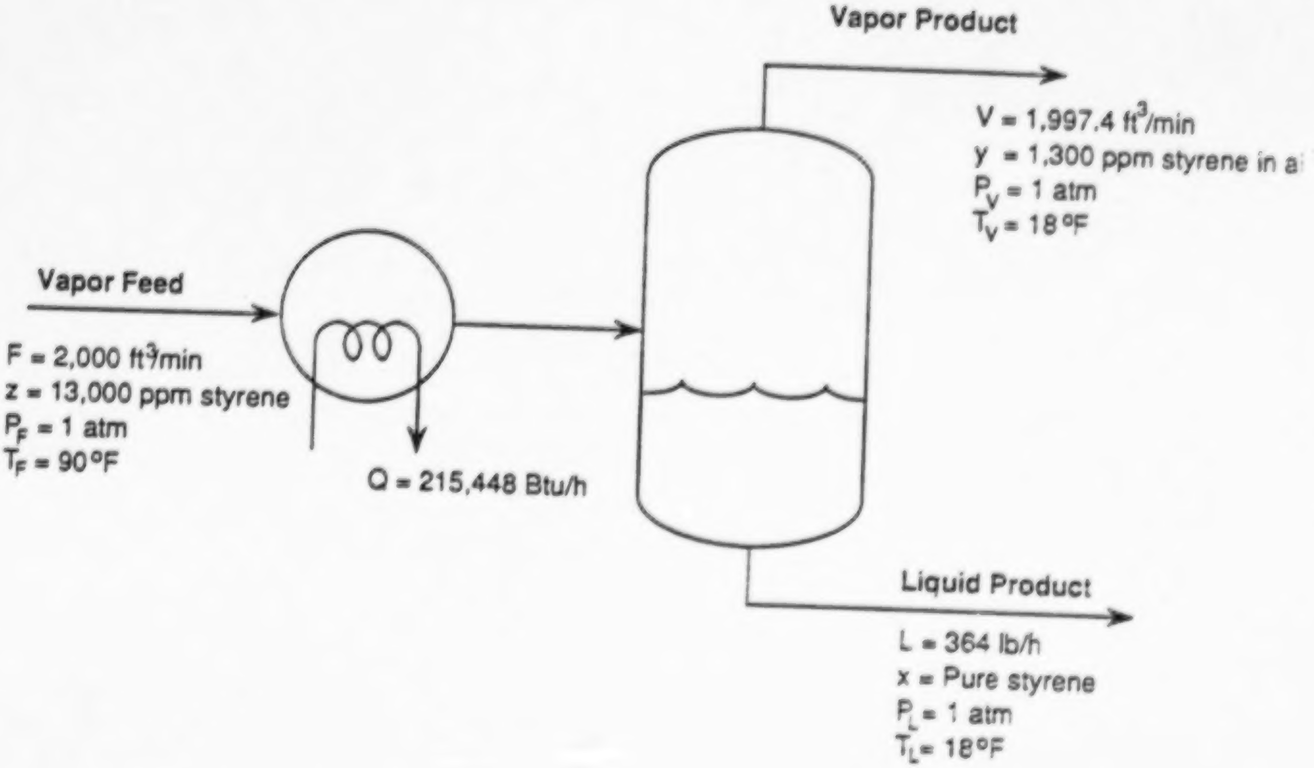

Figure C-4. Calculated parameters for a continuous, single-stage condenser.

# APPENDIX D

## EXAMPLE CALCULATION FOR CONDENSER HEAT BALANCE AS A CHECK ON CONDENSER DESIGN

# APPENDIX D

## EXAMPLE CALCULATION FOR CONDENSER HEAT BALANCE AS A CHECK ON CONDENSER DESIGN

### D.1 GENERAL DESCRIPTION OF EQUIPMENT

This appendix presents an example calculation where a heat balance is used to provide a preliminary or rough check of the condenser design. For a condensation system, the heat balance can be expressed as:

$$\text{Heat in} = \text{Heat out} \ .$$

$$\begin{matrix}\text{Heat required to reduce} \\ \text{vapors to the dewpoint}\end{matrix} + \begin{matrix}\text{Heat required to} \\ \text{condense vapors}\end{matrix} = \begin{matrix}\text{Heat needed to be} \\ \text{removed by the coolant}\end{matrix}$$

Facility X has two (2) thin-film evaporator systems. Each evaporator system consists of four (4) major components. The specifies of each component are as follows:

1. Thin-Film Evaporator - The thin-film evaporator is a Luwa Model LN0350 with 37.8 ft$^2$ of heated wall. It has the capability of evaporating a maximum of 350 gal/h under ideal conditions. The average steam requirement of the unit is approximately 600 lb/h of 100 psig steam.
2. Primary Condenser - The system requires a minimum condenser area of 350 ft$^2$. The condenser used at Facility X is 500 ft$^2$ and is a shell-and-tube type of condenser. The condenser will have the vapor in the tubes (which are 5/8 in. diameter).
3. Inner Condenser - The inner condenser has 28 ft$^2$ and is equipped with a steam ejector requiring 90 lb/h of steam.
4. After Condenser - The after condenser (sometimes called the outer condenser) has 21 ft$^2$ and is equipped with a steam ejector requiring 150 lb/h of steam.

## D.2 CALCULATION OF HEAT BALANCE

The thin-film evaporator system has one vent that is located at the "demister" tank (see Figure D-1). This vent is the final exhaust of the vacuum system after it has been cooled three times, scrubbed with steam and condensate, and impinged in the "demister." In calculating the theoretical heat balance, only the items after the primary condenser* will be considered.

For the purpose of calculation, consider the inner condenser and its heat transfer duty, and then determine the volume of vapors that it can condense. First, compute the amount of vapors being pulled into the ejector due to the vacuum. The vacuum system's design pressure is 1.5 in. Hg absolute (38 mmHg) of vacuum. The ejectors will exhaust 44 lb/h of air at a molecular weight of 29 lb/lb mole. The ejector capacity in terms of lb mole/h would be:

$$(44 \text{ lb/h})/(29 \text{ lb/lb mole}) = 1.52 \text{ lb mole/h} \quad . \qquad \text{(D-1)}$$

Assuming that the organics have a molecular weight of 132 lb/lb mole, the maximum amount of organics that could be exhausted by the ejector would therefore be:

$$132 \text{ lb/lb mole} \bullet 1.52 \text{ lb mole/h} = 200.64 \text{ lb/h} \quad . \qquad \text{(D-2)}$$

Please remember that for this to occur the primary condenser would have to be failing, and that is highly unlikely.

Now check the duty (i.e., $Q$ = the amount of heat that can be transferred by the condenser) of the inner condenser. The duty can be expressed by the following basic heat transfer equation (i.e., a derivation of Fourier's equation, $Q = -kadt/dx$, which is contained in all basic heat transfer books):

$$Q = UA \, dTln \quad . \qquad \text{(D-3)}$$

The surface area (A) of the inner condenser is 28 ft$^2$. For the purpose of calculation, a conservative value of 75 will be assumed for (U). It is the intent to solve for Q (which will provide the amount Btu/h the inner condenser will stand):

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*Note that primary condensers are considered as process equipment rather than air pollution control devices.

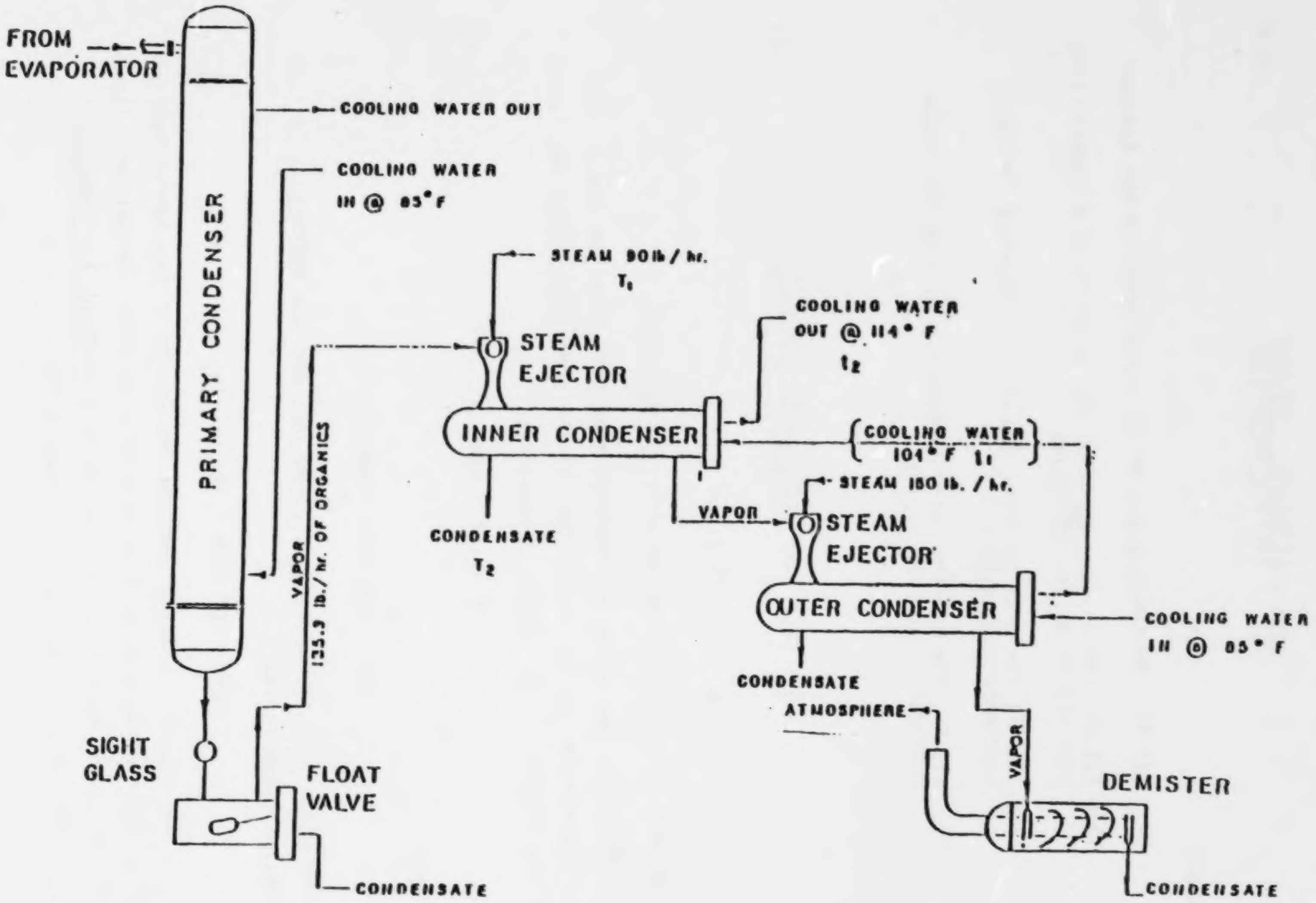

Figure D-1. Vacuum system.

$$dTln = \frac{[(T1-t2) - (T2-t1)]}{ln[T1-t2)/(T2-t1)]} \quad , \tag{D-4}$$

where:

$T1$ = 327 °F, the temperature of the steam entering the ejector

$T2$ = 125 °F, the boiling point of the organics at a conservative pressure of 26 in. Hg vacuum

$t1$ = 104 °F, the cooling water temperature entering the inner condenser (see Figure D-1)

$t2$= 114 °F, the cooling water temperature exiting the inner condenser (see Figure D-1).

Therefore:

$$Q = (75)\ (28)\ \frac{[(327-114)-(125-104)]}{[ln(327-114)/(124-104]} \quad , \tag{D-5}$$

$$Q = 174{,}035 \text{ Btu/h} \quad .$$

Thus, the duty of the inner condenser is 174,035 Btu/h.

Now determine the volume of organics that this duty can stand. This would be represented by the latent heat of the steam (LHs) plus the latent heat of the organic vapors (LHo). Therefore:

$$Q = LHs + LHo \quad , \tag{D-6}$$

where:

$$LHs = (90 \text{ lb/h} \bullet 888 \text{ Btu/lb}) \quad .$$

Note: The steam load to the ejector is 90 lb/h and the 888 Btu/lb is from the Saturated Steam Tables.

$$LHo = (X \text{ lb/h} \bullet 188 \text{ Btu/lb}) \quad . \tag{D-7}$$

Note: X is the organics loading, and the 188 Btu/lb is the latent heat of the organic vapor as determined from Antoine's equation and Watson's Correlation of the Latent Heat Equation (see Perry's Handbook for Chemical Engineers, Fifth Edition, Section 3-53, page 3-239).

Thus:

$$Q = LHs + LHo \qquad (D\text{-}8)$$

$$Q = (90 \bullet 888) + X \bullet 188) \quad ,$$

where:

$$Q = 174{,}035 \text{ Btu/h}$$

$$\begin{aligned} 174{,}035 &= (79{,}920) + (188X) \\ 94{,}115 &= 188X \\ X &= 500 \text{ lb/h} \quad . \end{aligned} \qquad (D\text{-}9)$$

Now, assuming an 85-percent efficiency factor for the condenser heat transfer, the removal capability of the inner condenser would be:

$$\begin{aligned} X &= 500 \bullet 0.85 \\ X &= 425 \text{ lb/h} \quad . \end{aligned} \qquad (D\text{-}10)$$

> Note: This efficiency factor was assumed based on the equipment/design of this particular system. An owner/operator performing similar calculations would need to assume an efficiency factor appropriate for the system of interest.

Therefore, the inner condenser could handle 425 lb/h. However, it was previously determined that the maximum loading to the inner condenser would be 201 lb/h. Thus, the inner condenser has the duty to remove the organics with an approximate two times safety factor.

A similar type of analysis can be performed for the after condenser as was performed previously for the inner condenser. The analysis is as follows:

Determine the duty of the after condenser by solving for Q,

where:

$$Q = UA\ dTln \quad , \qquad (D\text{-}11)$$

where:

$U = 75$

$A = 21 \text{ ft}^2$

$T1 = 327$ °F, the temperature of steam at 100 psi

T2 = 212 °F, the temperature of steam at atmospheric pressure

t1 = 85 °F, the temperature of the cooling water entering the condenser

t2 = 104 °F, the temperature of the cooling water exiting the condenser

$$dTln = \frac{[(327-104) - (212-85)]}{\ln[(327-104)/(212-85)]}$$

$$dTln = 170.52 \quad .$$

Therefore, Q is:

$$Q = (75)\ (21)\ (170.52) \tag{D-12}$$

$$Q = 268{,}568 \text{ Btu/h} \quad .$$

Assuming an 85 percent efficiency factor, the duty would then be:

$$Q = (268{,}568 \text{ Btu/h}) \cdot 0.85 \tag{D-13}$$

$$Q = 228{,}282 \text{ Btu/h} \quad .$$

Now, compare this duty to the latent heat of the steam being injected into the primary condenser. The latent heat of the steam (LHs) can be expressed as follows:

$$LHs = 150 \text{ lb/h} \times 888 \text{ Btu/lb} \tag{D-14}$$

$$LHs = 133{,}200 \text{ Btu/h} \quad .$$

Therefore, the latent heat of the steam is less than the duty of the after condensers. That is:

$$LHs < Q \tag{D-15}$$

$$133{,}200 \text{ Btu/h} < 228{,}282 \text{ Btu/h} \quad .$$

# APPENDIX E

## THE EFFECT OF CONCENTRATION ON CONDENSER EFFICIENCY AND EMISSIONS

# APPENDIX E

## THE EFFECT OF CONCENTRATION ON CONDENSER EFFICIENCY AND EMISSIONS

The actual conditions at which a particular gas will condense depends on its physical and chemical properties. Condensation occurs when the partial pressure of the pollutant in the gas stream equals its vapor pressure as a pure substance at operating conditions. Since the partial pressure of a compound is directly proportional to its mole fraction concentration, condensation of components of a gas stream with low concentrations can be difficult, especially for organics with low boiling points. Thus, the removal efficiency of a condenser is dependent upon the type (i.e., composition) of vapor stream entering the condenser as well as on condenser operating parameters.

In the case of multicomponent gas streams, different situations can occur when trying to condense vapors containing more than one organic component. In one case, all the organic components may condense at the coolant temperature. In another case, a few of the organic components may condense, while those components with low concentration and/or low boiling points will not condense.

In Appendix D, the thermodynamic properties of the process vent gas is used to check condenser design through a sample calculation. A similar type of analysis displaying the effect of concentration of a vent gas on condenser efficiency is presented here. Information on the cost of emission control systems is also provided. Efficiency and cost data were generated by a chemical engineering process simulator known as ASPEN (Advanced System for Process Engineering).

The ASPEN condenser configuration consists of:

- A floating-head, 1-pass, shell and tube heat exchanger
- A refrigeration unit capable of producing chilled brine at a temperature of -20 °F

- An optional-primary water-cooled heat exchanger (which might be necessary in some instance of high volatility organic condensation to reduce the size of the refrigeration unit or to remove water vapor and avoid freezing problems).

NOTE: In this example, complete removal of water vapor prior to organic condensation is assumed, recognizing that the condenser temperature is low enough to cause ice buildup on heat transfer surfaces. It is also important to note that ASPEN's cost correlation for heat exchangers was originally developed for plant-scale processes; therefore, cost scaling by condenser area for low flows typical of WSTF (waste solvent treatment facilities) has been added to ASPEN for this application.

Tables E-1, E-2, E-3, and E-4 clearly point out that condenser efficiency is highly dependent on the organic concentration of the gas stream. At low organic concentrations (e.g., <10 percent organics), the condenser efficiency tends to drop off rapidly as the concentration of the organic constituent is reduced. For the cases examined, high organic concentrations result in high efficiencies (see Figures E-1, E-2, and E-3). Other factors affecting the condenser efficiency are the physical properties of the solvent being condensed (e.g., volatility) and the operating temperature of the condenser.

It is of interest to note that in only 15 of the 40 cases examined was a removal efficiency of 95 percent achievable. In 7 of the 40 cases, the analysis indicated that for those particular situations appreciable condensation would not occur. This results from the partial pressure of the organics in the vapor phase being too low to thermodynamically support a liquid phase. Six of the seven cases involved methylene chloride as the organic constituent; methylene chloride has a boiling point of 40 °C (a relatively low boiling/high volatility compound). This compares with boiling points of 110 °C, 79 °C, and 74 °C for toluene, MEK, and 1,1,1 TCE, respectively. The seventh case that would not condense was a low concentration (1 percent) MEK.

A process vent control device such as a condenser will generally be required under the regulation to meet a 95-percent control efficiency. This will, of course, depend on the overall facility's process vent emission rate. In cases where condensation will not achieve a 95-percent control of

## TABLE E-1. CONSTITUENT: METHYLENE CHLORIDE (ME CHL)

| Case No. | Total flow, scfm | Organic rate, lb/h | Organic, % | Condenser efficiency |
|---|---|---|---|---|
| 1 | 8.3 | 0.40 | 1 | NC |
| 5 | 8.3 | 4.20 | 11 | NC |
| 9 | 8.3 | 10.60 | 25 | 44 |
| 13 | 1.2 | 0.17 | 3 | NC |
| 17 | 1.2 | 0.42 | 10 | NC |
| 21 | 1.2 | 1.20 | 20 | 26 |
| 25 | 1.2 | 5.00 | 59 | 87 |
| 29 | 0.6 | 0.08 | 3 | NC |
| 33 | 0.6 | 0.24 | 10 | NC |
| 37 | 0.6 | 1.00 | 31 | 58 |

NC = No condensation.

## TABLE E-2. CONSTITUENT: TOLUENE (TOL)

| Case No. | Total flow, scfm | Organic rate, lb/h | Organic, % | Condenser efficiency |
|---|---|---|---|---|
| 2 | 8.3 | 0.4 | 1 | 45 |
| 6 | 8.3 | 4.2 | 11 | 95 |
| 10 | 8.3 | 10.6 | 25 | 95 |
| 14 | 1.2 | 0.17 | 3 | 82 |
| 18 | 1.2 | 0.42 | 10 | 82 |
| 22 | 1.2 | 1.20 | 20 | 95 |
| 26 | 1.2 | 5.00 | 58 | 95 |
| 30 | 0.6 | 0.08 | 3 | 80 |
| 34 | 0.6 | 0.24 | 10 | 95 |
| 38 | 0.6 | 1.00 | 30 | 95 |

## TABLE E-3. CONSTITUENT: 1,1,1 TRICHLOROETHANE (1,1,1 TCE)

| Case No. | Total flow, scfm | Organic rate, lb/h | Organic, % | Condenser efficiency |
|---|---|---|---|---|
| 3 | 8.3 | 0.40 | 1 | 16 |
| 7 | 8.3 | 4.20 | 11 | 95 |
| 11 | 8.3 | 10.60 | 24 | 95 |
| 15 | 1.2 | 0.17 | 3 | 72 |
| 19 | 1.2 | 0.42 | 10 | 89 |
| 23 | 1.2 | 1.20 | 20 | 95 |
| 27 | 1.2 | 5.00 | 55 | 95 |
| 31 | 0.6 | 0.08 | 3 | 70 |
| 35 | 0.6 | 0.24 | 10 | 90 |
| 39 | 0.6 | 1.00 | 30 | 95 |

## TABLE E-4. CONSTITUENT: METHYL ETHYL KETONE (MEK)

| Case No. | Total flow, scfm | Organic rate, lb/h | Organic, % | Condenser efficiency |
|---|---|---|---|---|
| 4 | 8.3 | 0.40 | 1 | NC |
| 8 | 8.3 | 4.20 | 11 | 87 |
| 12 | 8.3 | 10.60 | 25 | 95 |
| 16 | 1.2 | 0.17 | 3 | 50 |
| 20 | 1.2 | 0.42 | 10 | 80 |
| 24 | 1.2 | 1.20 | 20 | 95 |
| 28 | 1.2 | 5.00 | 61 | 95 |
| 32 | 0.6 | 0.08 | 3 | 47 |
| 36 | 0.6 | 0.24 | 10 | 83 |
| 40 | 0.6 | 1.00 | 31 | 95 |

NC = No condensation.

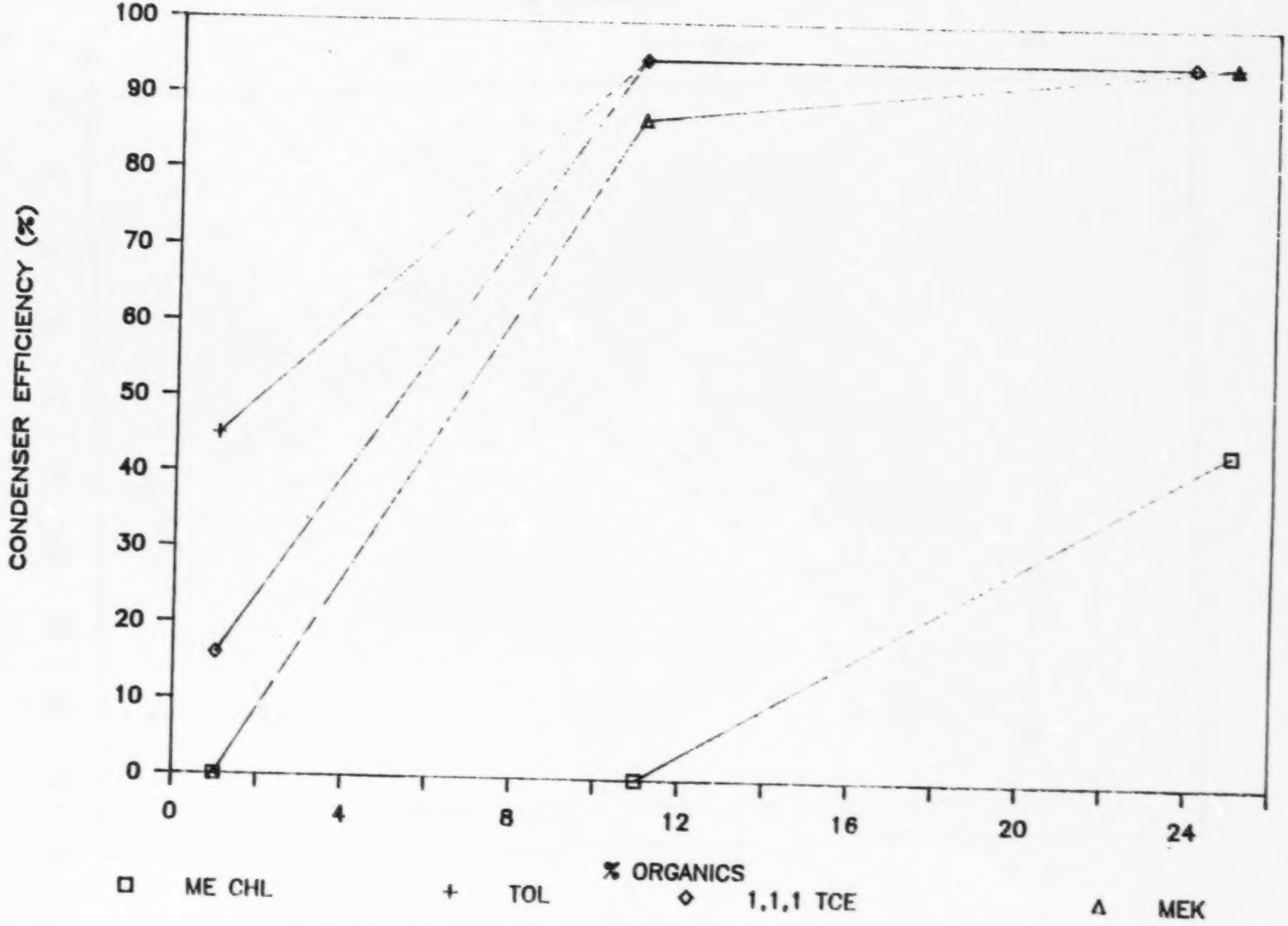

Figure E-1. Condenser efficiency vs. organic concentration (total flow [scfm] = 8.3).

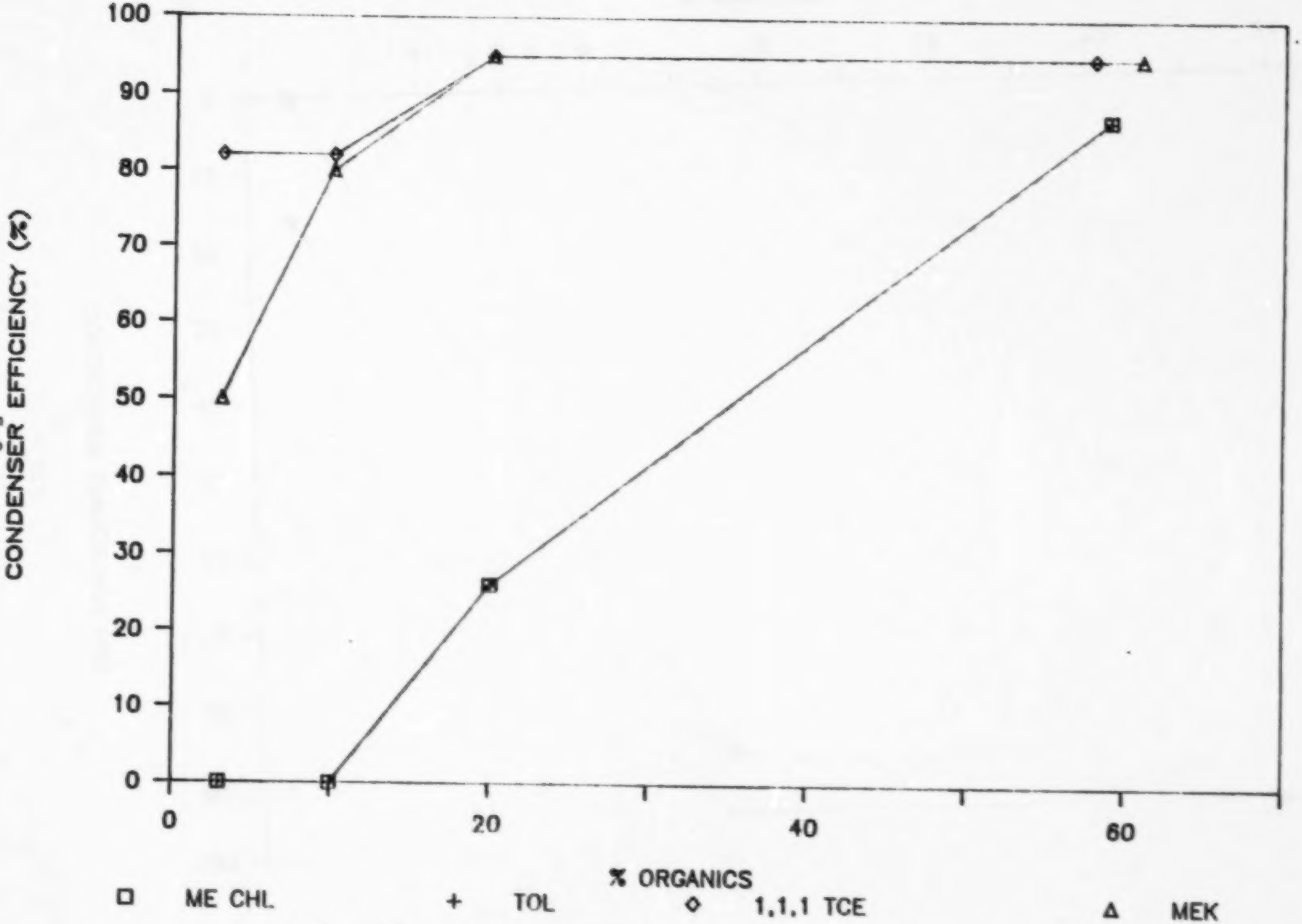

Figure E-2. Condenser efficiency vs. organic concentration (total flow [scfm] = 1.2).

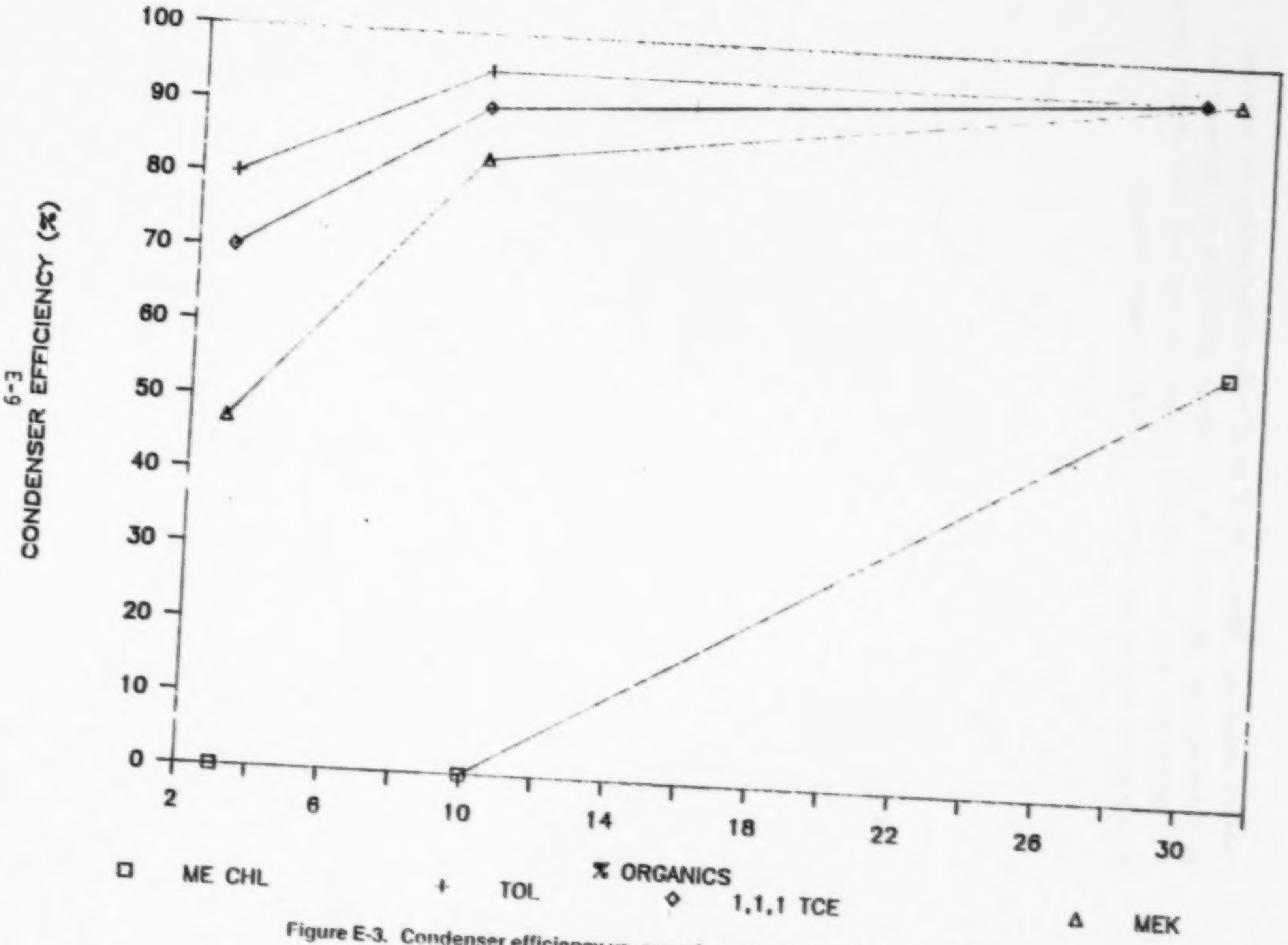

Figure E-3. Condenser efficiency vs. organic concentration (total flow [scfm] = 0.6).

organics reduction, some other type of control technology for emission reduction must be considered (e.g., carbon adsorption or incineration).

Tables E-5, E-6, E-7, and E-8 present the cost and cost effectiveness of condensers and carbon adsorbers for the example streams.

TABLE E-5. ASPEN CONDENSER DESIGN AND COST ESTIMATES FOR THE LARGE MODEL UNIT CASES (1-12), OPTION 1

| Parameter | Case No. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Coolant temperature (°F) | | -20 | -20 | | | -20 | -20 | -20 | -20 | -20 | -20 | -20 |
| Design heat load (W) | | 292 | 282 | | | 572 | 468 | 608 | 557 | 917 | 722 | 1,184 |
| Required condenser area ($m^2$) | | 0.319 | 0.307 | | | 0.624 | 0.51 | 0.683 | 0.607 | 0.691 | 0.561 | 1.28 |
| Refrigeration capacity (tons) | | 0.08 | 0.08 | | | 0.16 | 0.13 | 0.17 | 0.16 | 0.26 | 0.21 | 0.34 |
| Heat exchanger base cost (1986 $) | | 940 | 930 | | | 1,270 | 1,160 | 1,300 | 1,250 | 1,240 | 1,210 | 1,740 |
| Refrigeration base cost (1986 $) | | 1,600 | 1,560 | | | 2,540 | 2,210 | 2,650 | 2,490 | 3,510 | 2,980 | 4,180 |
| Electricity, refrigeration (1986 $) | | [a] | [a] | | | [a] | [a] | [a] | [a] | [a] | [a] | [a] |
| Base equipment cost (1986 $) | | 2,550 | 2,490 | | | 3,810 | 3,370 | 3,950 | 3,740 | 4,750 | 4,190 | 5,920 |
| Total capital investment (1986 $) | | 5,050 | 4,940 | | | 7,550 | 6,690 | 7,840 | 7,430 | 9,420 | 8,310 | 11,740 |
| Total annual cost (1986 $) | | 2,870 | 2,850 | | | 3,420 | 3,230 | 3,490 | 3,400 | 3,830 | 3,590 | 4,340 |
| Recovery credit ($/yr) | | 150 | 50 | | | 3,400 | 3,400 | 3,090 | 3,930 | 8,570 | 8,570 | 8,570 |
| Cost effectiveness ($/Mg VO removed) | | 8,160 | 25,200 | | | 0 | -20 | 60 | -60 | -250 | -260 | -220 |

Notes:

[a]Costs are less than $100.

1. Instrumentation: 10% of base equipment cost (BEC).
2. Sales tax and freight: 8% of BEC + instr.
3. Purchased equipment cost (PEC): BEC + instr. + (sales tax + freight).
4. Total installation cost (direct + indirect): 67% of PEC.
5. Total capital investment (TCI): PEC + total installation cost.
6. Supervision and admin. labor: 15% of direct labor.
7. Maintenance labor and materials: 3% of TCI.
8. Overhead: 60% of op. labor + supv./admn. + maint.
9. Property taxes, insurance, and admin. charges: 4% of TCI.
10. Capital recovery: 10% over a 15-year service life.
11. Absence of data in rows 1, 4, and 5 due to no condensation of organic gas stream (efficiency = 0%).

TABLE E-8. ASPEN CONDENSER DESIGN AND COST ESTIMATES FOR THE MEDIUM MODEL UNIT CASES (13-28), OPTION 1

| Parameter | Case No. | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| Coolant temperature (°F) | | -20 | -20 | -20 | | -20 | -20 | -20 | -20 | -20 | -20 | -20 | -20 | -20 | -20 | -20 |
| Design heat load (W) | | 61 | 48 | 49 | | 61 | 58 | 71 | 68 | 114 | 93 | 141 | 294 | 355 | 240 | 420 |
| Required condenser area ($m^2$) | | 0.056 | 0.05 | 0.053 | | 0.055 | 0.064 | 0.077 | 0.065 | 0.092 | 0.083 | 0.164 | 0.32 | 0.18 | 0.122 | 0.221 |
| Refrigeration capacity (tons) | | 0.01 | 0.01 | 0.01 | | 0.01 | 0.02 | 0.02 | 0.02 | 0.03 | 0.03 | 0.04 | 0.08 | 0.1 | 0.07 | 0.12 |
| Heat exchanger base cost (1988 $) | | 440 | 420 | 430 | | 440 | 480 | 510 | 470 | 520 | 520 | 600 | 950 | 720 | 820 | 880 |
| Refrigeration base cost (1988 $) | | 480 | 450 | 470 | | 480 | 530 | 610 | 640 | 840 | 730 | 970 | 1,010 | 1,030 | 1,400 | 2,060 |
| Electricity, refrigeration (1988 $) | | * | * | * | | * | * | * | * | * | * | * | * | * | * | * |
| Base equipment cost (1988 $) | | 920 | 870 | 890 | | 920 | 1,000 | 1,110 | 1,010 | 1,360 | 1,250 | 1,600 | 2,550 | 2,500 | 2,020 | 2,860 |
| Total capital investment (1988 $) | | 1,820 | 1,730 | 1,770 | | 1,820 | 1,980 | 2,210 | 2,000 | 2,690 | 2,480 | 3,200 | 5,070 | 5,000 | 4,000 | 5,670 |
| Total annual cost (1988 $) | | 2,170 | 2,150 | 2,180 | | 2,170 | 2,200 | 2,250 | 2,210 | 2,360 | 2,310 | 2,400 | 2,880 | 2,880 | 2,850 | 3,010 |
| Recovery credit ($/yr) | | 80 | 50 | 40 | | 150 | 180 | 140 | 130 | 400 | 490 | 480 | 1,850 | 2,020 | 2,020 | 2,020 |
| Cost effectiveness ($/Mg VO removed) | | 16,030 | 18,900 | 23,950 | | 8,060 | 5,740 | 8,700 | 7,200 | 1,720 | 1,890 | 1,840 | 260 | 190 | 140 | 220 |

Notes:

*Costs are less than $100.

1. Instrumentation: 10% of base equipment cost (BEC).
2. Sales tax and freight: 8% of BEC + instr.
3. Purchased equipment cost (PEC): BEC + instr. + (sales tax + freight).
4. Total installation cost (direct + indirect): 87% of PEC.
5. Total capital investment (TCI): PEC + total installation cost.
6. Supervision and admin. labor: 15% of direct labor.
7. Maintenance labor and materials: 3% of TCI.
8. Overhead: 60% of op. labor + supv./admn. + maint.
9. Property taxes, insurance, and admin. charges: 4% of TCI.
10. Capital recovery: 10% over a 15-year service life.
11. Absence of data in rows 13 and 17 due to no condensation of organic gas stream (efficiency = 0%).

TABLE E-7. ASPEN CONDENSER DESIGN AND COST ESTIMATES FOR THE SMALL MODEL UNIT CASES (29-40), OPTION 1

| Parameter | Case No. | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| Coolant temperature (°F) | | -20 | -20 | -20 | | -20 | -20 | -20 | -20 | -20 | -20 | -20 |
| Design heat load (W) | | 25 | 23 | 24 | | 37 | 31 | 38 | 55 | 79 | 61 | 103 |
| Required condenser area ($m^2$) | | 0.027 | 0.025 | 0.026 | | 0.04 | 0.33 | 0.042 | 0.06 | 0.046 | 0.041 | 0.069 |
| Refrigeration capacity (tons) | | 0.01 | 0.01 | 0.01 | | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 | 0.02 | 0.03 |
| Heat exchanger base cost (1986 $) | | 320 | 310 | 310 | | 380 | 350 | 390 | 450 | 400 | 380 | 540 |
| Refrigeration base cost (1986 $) | | 300 | 280 | 290 | | 390 | 340 | 400 | 510 | 660 | 540 | 780 |
| Electricity, refrigeration (1986 $) | | * | * | * | | * | * | * | * | * | * | * |
| Base equipment cost (1986 $) | | 610 | 590 | 600 | | 760 | 690 | 780 | 960 | 1,060 | 930 | 1,320 |
| Total capital investment (1986 $) | | 1,220 | 1,160 | 1,190 | | 1,520 | 1,370 | 1,550 | 1,900 | 2,100 | 1,840 | 2,620 |
| Total annual cost (1986 $) | | 2,030 | 2,020 | 2,030 | | 2,100 | 2,070 | 2,110 | 2,180 | 2,230 | 2,170 | 2,340 |
| Recovery credit ($/yr) | | 30 | 20 | 20 | | 100 | 90 | 80 | 250 | 400 | 400 | 400 |
| Cost effectiveness ($/Mg VO removed) | | 30,000 | 45,000 | 45,230 | | 9,000 | 9,900 | 11,420 | 3,470 | 2,060 | 1,990 | 2,180 |

Notes:

*Costs are less than $100.

1. Instrumentation: 10% of base equipment cost (BEC).
2. Sales tax and freight: 8% of BEC + instr.
3. Purchased equipment cost (PEC): BEC + instr. + (sales tax + freight).
4. Total installation cost (direct + indirect): 67% of PEC.
5. Total capital investment (TCI): PEC + total installation cost.
6. Supervision and admin. labor: 15% of direct labor.
7. Maintenance labor and materials: 3% of TCI.
8. Overhead: 60% of op. labor + supv./admn. + maint.
9. Property taxes, insurance, and admin. charges: 4% of TCI.
10. Capital recovery: 10% over a 15-year service life.
11. Absence of data in rows 29 and 33 due to no condensation of organic gas stream (efficiency = 0%).

## TABLE E-8. CARBON ADSORPTION CONTROL COSTS FOR MODEL UNIT CASES NOT ACHIEVING 95% CONTROL WITH CONDENSERS, OPTION 1

| Parameter | Case No. | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 | 8 | 9 | 17 | 18 | 19 | 20 | 21 | 26 | 33 | 36 | 38 | 37 |
| Constituent | MECHL | MEK | MECHL | MECHL | TOL | TCE | MEK | MECHL | MECHL | MECHL | TCE | MEK | MECHL |
| Flow rate (acfm) | 0.3 | 0.3 | 0.3 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 0.6 | 0.6 | 0.6 | 0.6 |
| Emission rate (lb/h) | 4.20 | 4.20 | 10.00 | 0.42 | 0.42 | 0.42 | 0.42 | 1.20 | 5.00 | 0.24 | 0.24 | 0.24 | 1.00 |
| Operating hours (h/yr) | 4,100 | 4,100 | 4,100 | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 | 2,000 |
| Mole percent (%) | 3.9 | 4.9 | 9.0 | 2.7 | 2.5 | 1.7 | 3.2 | 7.7 | 31.9 | 3.1 | 2 | 3.6 | 12.8 |
| LEL (ppmv) | [a] | 19,000 | [a] | [a] | 14,000 | [a] | 19,000 | [a] | [a] | [a] | [a] | 19,000 | [a] |
| Carbon capacity (lb/1,000 lb) | 100 | 80 | 100 | 100 | 70 | 150 | 80 | 100 | 100 | 100 | 150 | 80 | 100 |
| Total capital investment (1988 $) | 102,640 | 101,730 | 97,300 | 1,050 | 1,050 | 1,050 | 1,050 | 101,000 | 103,100 | 1,050 | 1,050 | 1,050 | 201,530 |
| Annual operating costs (1988 $) | 40,170 | 40,490 | 41,000 | 10,330 | 24,030 | 12,400 | 22,210 | 43,130 | 40,400 | 10,510 | 7,090 | 13,130 | 43,400 |
| Total annual costs (1988 $) | 50,430 | 50,510 | 60,440 | 10,500 | 25,000 | 12,030 | 22,300 | 74,090 | 50,000 | 10,000 | 0,000 | 13,300 | 70,100 |
| Recovery credit ($/yr) | 3,400 | 3,400 | 8,570 | 0 | 0 | 0 | 0 | 400 | 2,020 | 0 | 0 | 0 | 400 |
| Cost effectiveness ($/Mg VO removed) | 7,030 | 7,040 | 2,510 | 40,040 | 80,270 | 33,400 | 59,330 | 80,290 | 12,170 | 40,540 | 37,390 | 81,700 | 84,370 |

Notes:

[a] LEL assumed to be 17,500 ppmv.

1. The constituents are methyl ethyl ketone (MEK), methylene chloride (MECHL), toluene (TOL), and 1,1,1 trichloroethane (TCE).
2. The carbon adsorption systems for Cases 8, 9, 21, 26, and 37 involve use of a fixed bed regenerable system.
3. The carbon adsorption systems for Cases 17, 18, 19, 20, 33, 36, and 38 involve use of carbon cannisters.
4. Carbon cannisters are not regenerated on site and a recovery credit is not appropriate.
5. Costs for carbon adsorption systems were estimated using the EPA/EAB Control Cost Manual, EPA 450/5-87-001A, February 1987.

# APPENDIX F

# DESIGN CHECKLISTS

## CARBON ADSORPTION DESIGN CHECKLIST

**Attribute**

Inlet gas:
- ☐ Flow rate (dscm/h)[*]
- ☐ Concentration (ppm)[*]
- ☐ Pressure (mmHg)[†]
- ☐ Relative humidity[*]
- ☐ Composition[*]
- ☐ MW (kg/g-mole)[†]
- ☐ BP (°C)[†]
- ☐ LEL (% by volume)[†]
- ☐ Temperature (°C)[*]

Particulate matter:
- ☐ Composition[†]
- ☐ Density[†]
- ☐ Shape[†]
- ☐ Mass mean aerodynamic diameter[‡]

Exit gas:
- ☐ Concentration (ppm)[‡]

Performance:
- ☐ Adsorption efficiency (%)[†]

**Attribute**

Absorber:
- ☐ Superficial gas velocity (m/min)[†]
- ☐ Cycle time (min)[†]
- ☐ Bed cross-section area ($m^2$/adsorber)[†]
- ☐ Bed depth (cm)[†]
- ☐ Transfer zone depth (cm)[†]
- ☐ Pressure drop (mmHg)[†]
- ☐ Sorption capacity (kg contaminant/kg adsorbent)[†]
- ☐ Working capacity (kg contaminant/kg adsorbent)[†]
- ☐ Heat of adsorption (J/kg adsorbed)[†]
- ☐ Number of adsorber beds[‡]
- ☐ Capacity of adsorption beds[‡]
- ☐ Type of adsorption bed[‡]

Adsorbent:
- ☐ Type[†]
- ☐ Form (shape)[†]
- ☐ Size[†]
- ☐ Activity[†]
- ☐ Maximum temperature (°C)[†]
- ☐ Density ($kg/m^3$)[†]
- ☐ Life/years @ conditions[†]
- ☐ Pressure drop ($Pa/m^3$ bed depth)[†]

**Attribute**

Regeneration:
- ☐ Fluid type[†]
  - ☐ Rate (L/min)[‡]
  - ☐ Pressure (mmHg)[†]
  - ☐ Temperature (°C)[†]
- ☐ Desorption time[‡]
- ☐ Drying fluid type[†]
- ☐ Drying time[‡]
- ☐ Cooling time[‡]
- ☐ Temperature after regeneration[‡]

- ☐ Carbon replacement interval (if nonregenerative) based on the total carbon working capacity of the control device and source operating schedule[‡]

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Notes: [*] Indicates a parameter/attribute that must be **considered** in the design analysis in order to satisfy the requirements of Subpart AA.

[†] Indicates a parameter/attribute that could be useful in the design analysis but is not required to be established or considered to satisfy the requirements of Subpart AA.

[‡] Indicates a parameter/attribute that must be **established** in the design analysis in order to satisfy the requirements of Subpart AA.

## CONDENSER DESIGN CHECKLIST

**Attribute**

Inlet gas:
- ☐ Concentration (ppm)*
- ☐ Composition*
- ☐ Flow rate (dscm/h)*
- ☐ Temperature (°C)*
- ☐ Pressure (mmHg)†
- ☐ Relative humidity*
- ☐ MW (kg/g-mole)†

Exit gas:
- ☐ Concentration (ppm)‡
- ☐ Temperature (°C)†

Coolant:
- ☐ Type†
- ☐ Specific heat†
- ☐ Rate †
- ☐ Temperature in (°C)‡
- ☐ Temperature out (°C)‡
- ☐ Pressure (mmHg)†

**Attribute**

Condenser:
- ☐ Type†
- ☐ Material of construction†
- ☐ Heat transfer area†
- ☐ Pressure drop†
- ☐ Overall heat transfer coefficient†

Performance:
- ☐ Condensation efficiency (%)†

**Attribute**

Notes: *Indicates a parameter/attribute that must be **considered** in the design analysis in order to satisfy the requirements of Subpart AA.

†Indicates a parameter/attribute that could be useful in the design analysis but is not required to be established or considered to satisfy the requirements of Subpart AA.

‡Indicates a parameter/attribute that must be **established** in the design analysis in order to satisfy the requirements of Subpart AA.

## COMBUSTION DEVICES DESIGN CHECKLIST

**Attribute**
**(Thermal incinerator)**

Inlet gas:
- ☐ Flow rate (dscm/h)[*]
- ☐ Temperature (°C)[†]
- ☐ Pressure (mmHg)[†]
- ☐ Density (kg/m$^3$)[†]
- ☐ Composition[*]
- ☐ Concentration (ppm)[*]
- ☐ Particulate loading (kg/h)[†]
- ☐ Specific heat[†]
- ☐ LEL (% by volume)[†]

Exit gas:
- ☐ Flow rate (dscm/h)[†]
- ☐ Temperature (°C)[†]
- ☐ Pressure (mmHg)[†]
- ☐ Particulate loading (lb/h)[†]

- ☐ Auxiliary fuel available[†]
- ☐ Auxiliary fuel pressure (mmHg)[†]
- ☐ Compressed air pressure (mmHg)[†]

Incinerator:
- ☐ Dimensions[†]
- ☐ Combustion zone temperature (°C)[‡]
- ☐ Combustion zone residence time (s)[‡]
- ☐ Combustion zone minimum temperature (°C)[‡]
- ☐ Pressure drop[†]

**Attribute**
**(Catalytic incinerator)**

Inlet gas:
- ☐ Flow rate (dscm/h)[*]
- ☐ Temperature (°C)[†]
- ☐ Pressure (mmHg)[†]
- ☐ Density (kg/m$^3$)[†]
- ☐ Composition[*]
- ☐ Concentration (ppm)[*]
- ☐ Particulate loading (kg/h)[†]
- ☐ Specific heat[†]
- ☐ LEL (% by volume)[†]

Exit gas:
- ☐ Flow rate (dscm/h)[†]
- ☐ Temperature (°C)[†]
- ☐ Pressure (mmHg)[†]
- ☐ Particulate loading (kg/h)[†]

- ☐ Auxiliary fuel available[†]
- ☐ Auxiliary fuel pressure (mmHg)[†]
- ☐ Compressed air pressure (mmHg)[†]

Incinerator:
- ☐ Dimensions[†]
- ☐ Catalyst bed depth (cm)[†]
- ☐ Inlet and outlet temperature across the catalyst bed (°C)[‡]
- ☐ Inlet and outlet minimum across the catalyst bed (°C)[‡]
- ☐ Pressure drop[†]

**Attribute**
**(Boilers or process heaters)**

Inlet gas:
- ☐ Flow rate (dscm/h)[*]
- ☐ Temperature (°C)[†]
- ☐ Pressure (mmHg)[†]
- ☐ Density (kg/m$^3$)[†]
- ☐ Composition[*]
- ☐ Concentration (ppm)[*]
- ☐ Particulate loading (lb/h)[†]
- ☐ Specific heat[†]
- ☐ LEL (% by volume)[†]

Exit gas:
- ☐ Flow rate (dscm/h)[†]
- ☐ Temperature (°C)[†]
- ☐ Pressure (mmHg)[†]
- ☐ Particulate loading (kg/h)[†]

- ☐ Auxiliary fuel available[†]
- ☐ Auxiliary fuel pressure (mmHg)[†]
- ☐ Compressed air pressure (mmHg)[†]

Boiler (combustion chamber):
- ☐ Dimensions[†]
- ☐ Flame zone temperature (°C)[‡]
- ☐ Flame zone minimum temperature (°C)[‡]
- ☐ Flame zone residence time (s)[‡]
- ☐ Description of the method and location where the vent stream is introduced into the flame zone[‡]

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Notes: [*] Indicates a parameter/attribute that must be **considered** in the design analysis in order to satisfy the requirements of Subpart AA.

[†] Indicates a parameter/attribute that could be useful in the design analysis but is not required to be established or considered to satisfy the requirements of Subpart AA.

[‡] Indicates a parameter/attribute that must be **established** in the design analysis in order to satisfy the requirements of Subpart AA.

# FLARES

## DESIGN CHECKLIST

1. Is the flare designed for and operated with no visible emissions by methods specified in Sections 264.1033(e)(1) and 265.1033(e)(1), except for periods not to exceed a total of 5 minutes during 2 consecutive hours? ____ Yes ____ No

2. Is the flare operated with a flame present at all times, as determined by the methods specified in Sections 264.1033(f)(2)(iii) and 265.1033(f)(2)(iii)? ____ Yes ____ No

3. Is the net heating value of the gas being combusted in a steam-assisted or air-assisted flare 11.2 mJ/scm (300 Btu/scf) or greater? (Note: The net heating value of the gas being combusted shall be determined by the methods specified in Sections 265.1033(e)(2) and 265.1033(e)(2)). ____ Yes ____ No

4. Is the net heating value of the gas being combusted in a nonassisted flare 7.45 MJ/scm (200 Btu/scf) or greater? (Note: The net heating value of the gas being combusted shall be determined by the methods specified in Sections 264.1033(e)(2) and 265.1033(e)(2)). ____ Yes ____ No

5. Are steam-assisted and nonassisted flares designed for and operated with an exit velocity, as determined by the methods specified in Sections 264.1033(e)(3) and 265.1033(e)(3), equal to or greater than 18.3 m/s (60 ft/s), but less than 122 m/s (400 ft/s) combusting a gas whose net heating value is greater than 37.3 MJ/scm (1,000 Btu/scf)? ____ Yes ____ No

6. Are steam-assisted and nonassisted flares designed for and operated with an exit velocity, as determined by the methods specified in Sections 264.1033(e)(3) and 265.1033(e)(3), less than the velocity, Vmax, as determined by the method specified in Sections 264.1033(e)(4) and 265.1033(e)(4), and less than 122 m/s (400 ft/s)? ____ Yes ____ No

7. Are air-assisted flares designed and operated with an exit velocity, Vmax, as determined by the method specified in Sections 264.1033(e)(5) and 265.1033(e)(5)? ____ Yes ____ No

8. Does the design analysis for assisted and nonassisted flares consider the vent stream composition, constituent concentrations, and flow rate? ____ Yes ____ No

# APPENDIX G

# RESPONSE FACTORS OF VOC ANALYZERS FOR SELECTED ORGANIC CHEMICALS

# APPENDIX G

# RESPONSE FACTORS OF VOC ANALYZERS FOR SELECTED ORGANIC CHEMICALS

This appendix presents the results of a laboratory study on the sensitivity of two portable volatile organic compound (VOC) analyzers to a variety of organic chemicals. The two analyzers tested were the Century Systems OVA-108 and the Bacharach TLV Sniffer.

In Table G-1 are response factors for a 10,000-ppmv meter reading of the instruments along with the 95 percent confidence intervals. The instruments were calibrated to 7,993 ppmv methane gas.

Most of the response factors and associated confidence intervals were calculated using the classical regression method; those computed using the inverse regression method are noted in this table with the explanatory code "I". Other explanatory codes used indicate data availability, date applicability, and possible data uncertainties such as the presence of outliers.

Table G-2 lists compounds tested that do not appear to respond at a 10,000 ppmv reading at any concentration. Questionable or borderline cases were included in Table G-1 rather than Table G-2.

## REFERENCE

Environmental Protection Agency (EPA). September 1981. "Response Factors of VOC Analyzers at a Meter Reading of 10,000 ppmv for Selected Organic Compounds." EPA 600/2-81-051. Research Triangle Park, NC.

### TABLE G-1. RESPONSE FACTORS WITH 95 PERCENT CONFIDENCE INTERVALS ESTIMATED AT 10.000 PPMV RESPONSE

| OCPDB* ID no. | Compound name | Volatility class** | OVA | | TLV | |
|---|---|---|---|---|---|---|
| | | | Response factor | Confidence intervals | Response factor | Confidence intervals |
| 70 | Acetic acid | LL | 1.64 | 1.11, 2.65 | 15.60 | 7.05, 46.20 |
| 80 | Acetic anhydride | LL | 1.39 | 1.09, 1.86 | 5.88 I | 2.71, 12.80 |
| 90 | Acetone | LL | 0.80 | 0.57, 1.20 | 1.22 | 0.81, 2.00 |
| 100 | Acetone cyanohydrin | HL | 3.51 | 0.69, >100.00 | 21.00 N | 1.09, >100.00 |
| 110 | Acetonitrile | LL | 0.95 | 0.85, 1.06 | 1.18 | 0.94, 1.52 |
| 120 | Acetophenone | HL | 18.70 | 5.52, >100.00 | B | |
| 125 | Acetyl chloride | LL | 2.04 | 1.72, 2.48 | 2.72 | 1.65, 5.32 |
| 130 | Acetylene | G | 0.39 | 0.36, 0.43 | B | |
| 150 | Acrylic acid | LL | 4.59 | 3.38, 6.57 | B | |
| 170 | Acrylonitrile | LL | 0.97 | 0.80, 1.20 | 3.49 I | 0.44, 27.90 |
| | Allene | G | 0.64 | 0.60, 0.69 | 15.00 | 9.68, 26.50 |
| 200 | Allyl alcohol | LL | 0.96 | 0.76, 1.27 | X | |
| 250 | Amyl alcohol, N- | HL | 0.75 | 0.57, 1.04 | 2.14 | 0.45, >100.00 |
| 2855 | Amylene | LL | 0.44 | 0.34, 0.61 | 1.05 | 0.59, 2.59 |
| 350 | Anisole | LL | 0.92 | 0.65, 1.46 | 3.91 | 0.52, >100.00 |
| 360 | Benzaldehyde | HL | 2.46 | 1.38, 5.62 | B | |
| 380 | Benzene | LL | 0.29 | 0.28, 0.51 | 1.07 | 0.96, 1.20 |
| 450 | Benzonitrile | HL | 2.99 | 1.18, 15.30 | B | |
| 490 | Benzoyl chloride | HL | 22.10 D | 3.43, >100.00 | B | |
| 530 | Benzyl chloride | HL | 15.30 D | 3.96, >100.00 | B | |
| 570 | Bromobenzene | LL | 0.40 | 0.34, 0.48 | 1.19 | 0.27, >100.00 |
| 590 | Butadiene, 1,3- | G | 0.57 | 0.54, 0.60 | 10.90 | 8.11, 15.40 |
| | Butane, N- | G | 0.50 | 0.46, 0.55 | 0.63 | 0.58, 0.70 |
| 640 | Butanol, N- | LL | 1.44 I | 0.89, 2.34 | 4.11 I | 2.16, 7.83 |
| 650 | Butanol, Sec- | LL | 0.76 | 0.70, 0.83 | 1.25 | 0.99, 1.66 |
| 660 | Butanol, Tert- | S | 0.55 | 0.38, 0.81 | 2.17 | 1.34, 4.43 |
| 592 | Butene, 1- | G | 0.56 | 0.51, 0.62 | 5.84 | 4.20, 8.89 |
| 600 | Butyl acetate | LL | 0.66 | 0.54, 0.83 | 1.38 | 1.15, 1.70 |
| 650 | Butyl acrylate, N- | LL | 0.70 | 0.63, 0.78 | 2.57 I | 1.17, 5.68 |
| | Butyl ether, N- | LL | 2.60 | 0.81, 95.60 | 3.58 I | 1.82, 7.04 |
| | Butyl ether, Sec- | LL | 0.35 | 0.21, 0.95 | 1.15 | 0.75, 2.17 |
| 670 | Butylamine, N- | LL | 0.69 | 0.53, 0.98 | 2.02 | 1.14, 4.97 |
| 680 | Butylamine, Sec- | LL | 0.70 | 0.58, 0.87 | 1.56 | 0.77, 5.24 |
| 690 | Butylamine, Tert- | LL | 0.62 | 0.58, 0.70 | 1.95 | 1.42, 2.91 |
| | Butylbenzene, Tert- | HL | 1.32 | 0.89, 2.20 | B | |
| 750 | Butyraldehyde, N- | LL | 1.29 | 1.07, 1.61 | 2.30 | 0.96, 12.80 |
| 760 | Butyric acid | HL | 0.86 | 0.38, 3.14 | 10.70 I | 6.53, 17.60 |
| 780 | Butyronitrile | LL | 0.52 | 0.40, 0.74 | 1.47 I | 0.62, 3.48 |
| 790 | Carbon disulfide | LL | B | | 3.92 | 1.87, 12.60 |
| 830 | Chloroacetaldehyde | LL | 9.10 | 5.73, 16.20 | 5.07 | 3.06, 9.79 |
| 890 | Chlorobenzene | LL | 0.39 | 0.32, 0.47 | 0.86 | 0.77, 1.00 |
| 1740 | Chloroethane | G | 5.38 I | 1.87, 26.40 | 3.90 P | 1.58, 14.10 |
| 930 | Chloroform | LL | 9.28 | 5.19, 20.00 | B | |
| 960 | Chlorophenol, O- | HL | 4.56 | 1.72, 27.20 | 18.30 I | 6.50, 51.50 |
| | Chloropropene, 1- | LL | 0.67 | 0.61, 0.73 | 0.87 | 0.69, 1.16 |
| 210 | Chloropropene, 3- | LL | 0.80 | 0.72, 0.90 | 1.24 | 1.08, 1.42 |
| 970 | Chlorotoluene, M- | LL | 0.48 | 0.45, 0.51 | 0.91 | 0.40, 7.47 |
| 980 | Chlorotoluene, O- | LL | 0.48 | 0.42, 0.55 | 1.06 | 0.32, >100.00 |
| 990 | Chlorotoluene, P- | LL | 0.56 | 0.52, 0.61 | 1.17 I | 0.77, 1.77 |
| 1010 | Cresol, O- | S | 0.96 | 0.70, 1.45 | 4.36 I | 0.40, 47.40 |
| 1040 | Crotonaldehyde | LL | 1.25 | 0.82, 2.24 | B | |
| 1060 | Cumene | LL | 1.87 | 1.10, 3.71 | B | |
| 1120 | Cyclohexane | LL | 0.47 | 0.39, 0.58 | 0.70 | 0.62, 0.80 |
| 1130 | Cyclohexanol | HL | 0.85 | 0.65, 1.20 | B | |
| 1140 | Cyclohexanone | LL | 1.50 | 0.97, 2.76 | 7.04 | 1.59, >100.00 |
| 1150 | Cyclohexene | LL | 0.49 | 0.42, 0.57 | 2.17 | 1.78, 2.74 |
| 1160 | Cyclohexylamine | LL | 0.57 | 0.42, 0.86 | 1.38 | 1.28, 1.48 |
| | Decane | HL | 0.09 N | 0.05, >100.00 | 0.16 I | 0.07, 0.35 |
| 1190 | Diacetone alcohol | HL | 1.45 | 0.96, 2.48 | 0.98 | 0.44, 5.93 |
| | Diacetyl | LL | 1.34 | 1.25, 1.92 | 3.28 | 2.25, 5.12 |
| 1270 | Dichloro-1-propene, 2,3- | LL | 0.75 | 0.56, 1.09 | 1.75 | 1.14, 3.18 |
| 1215 | Dichlorobenzene, M- | HL | 0.64 | 0.55, 0.77 | 2.36 | 0.58, >100.00 |
| 1216 | Dichlorobenzene, O- | HL | 0.68 | 0.47, 1.11 | 1.26 | 0.35, >100.00 |
| | Dichloroethane, 1,1- | LL | 0.78 | 0.62, 1.02 | 1.86 | 1.56, 2.25 |
| 1244 | Dichloroethane, 1,2- | LL | 0.95 | 0.77, 1.22 | 2.15 | 1.66, 2.92 |

## TABLE G-1 (continued)

| OCPDB* ID no. | Compound name | Volatility class** | OVA | | | | TLV | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Response factor | | Confidence intervals | | Response factor | | Confidence intervals | |
| 1235 | Dichloroethylene, CIS1,2- | LL | 1.27 | | 1.09, | 1.36 | 1.63 | | 0.99, | 3.47 |
| 1236 | Dichloroethylene, TRANS 1,2- | LL | 1.11 | | 0.98, | 1.27 | 1.66 | | 0.67, | 12.80 |
| 2620 | Dichloromethane | LL | 2.61 | | 2.13, | 3.87 | 3.85 | | 2.46, | 6.88 |
| 3110 | Dichloropropane, 1,2- | LL | 1.05 | | 0.82, | 1.33 | 1.65 | | 1.06, | 3.05 |
| 1440 | Diisobutylene | LL | 0.35 | | 0.29, | 0.44 | 1.41 | | 0.96, | 2.40 |
| 1870 | Dimethoxy ethane, 1,2- | LL | 1.22 | | 0.64, | 3.61 | 1.82 | | 0.65, | 8.38 |
| 1490 | Dimethylformamide, N,N- | LL | 4.19 | | 2.90, | 6.58 | 5.29 | | 4.05, | 7.20 |
| 1495 | Dimethylhydrazine 1,1- | LL | 1.05 | | 0.77, | 1.45 | 2.70 | | 0.51, | >100.00 |
| 1520 | Dimethylsulfoxide | HL | 0.07 | I | 0.05, | 0.11 | 8.45 | I | 4.15, | 17.20 |
| 1480 | Dioxane | LL | 1.48 | | 1.04, | 2.35 | 1.31 | | 0.70, | 3.60 |
| 1650 | Epichlorohydrin | LL | 1.69 | | 1.36, | 1.84 | 2.03 | | 1.79, | 2.33 |
| | Ethane | G | 0.65 | | 0.44, | 1.58 | 0.69 | I | 0.21, | 2.30 |
| 1660 | Ethanol | LL | 1.78 | | 1.59, | 2.01 | | X | | |
| 1910 | Ethoxy ethanol, 2- | LL | 1.55 | | 1.26, | 1.96 | 1.82 | | 0.96, | 5.12 |
| 1670 | Ethyl acetate | LL | 0.86 | | 0.77, | 0.95 | 1.45 | | 1.07, | 2.00 |
| 1680 | Ethyl acetoacetate | HL | 3.82 | | 1.89, | 10.70 | 5.60 | | 1.95, | 58.80 |
| 1690 | Ethyl acrylate | LL | 0.77 | | 0.65, | 0.97 | | X | | |
| 1750 | Ethyl chloroacetate | LL | 1.99 | | 1.70, | 2.36 | 1.59 | | 0.40, | >100.00 |
| 1990 | Ethyl ether | LL | 0.97 | | 0.77, | 1.30 | 1.14 | | 0.94, | 1.42 |
| 1710 | Ethylbenzene | LL | 0.73 | | 0.52, | 1.11 | 4.74 | D | 1.38, | 61.50 |
| 1770 | Ethylene | G | 0.71 | | 0.65, | 0.87 | 1.56 | | 1.26, | 2.06 |
| 1980 | Ethylene oxide | G | 2.46 | | 1.95, | 3.29 | 2.40 | | 0.96, | >100.00 |
| 1800 | Ethylenediamine | LL | 1.73 | | 1.29, | 2.46 | 3.28 | | 0.78, | >100.00 |
| 2060 | Formic acid | LL | 14.20 | | 10.60, | 19.80 | | B | | |
| 2105 | Glycidol | LL | 6.88 | | 5.35, | 19.70 | 5.06 | | 2.08, | 34.70 |
| | Heptane | LL | 0.41 | I | 0.28, | 0.60 | 0.73 | | 0.35, | 6.10 |
| | Hexane, N- | LL | 0.41 | | 0.36, | 0.45 | 0.69 | | 0.65, | 0.76 |
| | Hexene, 1- | LL | 0.49 | | 0.39, | 0.66 | 4.69 | D | 0.85, | >100.00 |
| | Hydroxyacetone | LL | 6.90 | | 4.65, | 12.10 | 15.20 | | 6.11, | 66.40 |
| | Isobutane | G | 0.41 | | 0.29, | 1.04 | 0.56 | | 0.41, | 0.81 |
| 2200 | Isobutylene | G | 5.13 | | 0.90, | 38.50 | | B | | |
| 2350 | Isoprene | LL | 0.59 | | 0.46, | 0.80 | | X | | |
| 2360 | Isopropanol | LL | 0.91 | | 0.72, | 1.20 | 1.39 | | 0.94, | 2.31 |
| 2370 | Isopropyl acetate | LL | 0.71 | | 0.62, | 0.85 | 1.31 | | 1.04, | 1.72 |
| 2390 | Isopropyl chloride | LL | 0.68 | | 0.60, | 0.77 | 0.98 | | 0.82, | 1.22 |
| | Isovaleraldehyde | LL | 0.64 | | 0.57, | 0.74 | 2.19 | D | 1.14, | 6.65 |
| 2450 | Mesityl oxide | LL | 1.09 | | 0.94, | 1.29 | 3.14 | | 1.43, | 12.00 |
| | Methacrolein | LL | 1.20 | | 0.90, | 1.71 | 3.46 | D | 1.51, | 19.80 |
| 2460 | Methacrylic acid | HL | 0.82 | | 0.51, | 14.70 | 1.06 | I | 0.24, | 4.56 |
| 2500 | Methanol | LL | 4.39 | P | 3.61, | 5.60 | 2.01 | | 1.66, | 2.48 |
| 1950 | Methoxy-ethanol, 2- | LL | 2.25 | | 1.62, | 3.34 | 3.12 | | 1.15, | 27.40 |
| 2510 | Methyl acetate | LL | 1.74 | | 1.46, | 2.13 | 1.85 | | 1.44, | 2.49 |
| | Methyl acetylene | G | 0.61 | | 0.58, | 0.64 | 6.79 | | 4.86, | 10.40 |
| 2560 | Methyl chloride | G | 1.44 | | 1.22, | 1.76 | 1.84 | | 0.73, | >100.00 |
| 2640 | Methyl ethyl ketone | LL | 0.64 | | 0.51, | 0.84 | 1.12 | | 0.93, | 1.38 |
| 2645 | Methyl formate | LL | 3.11 | | 2.42, | 4.14 | 1.94 | | 1.72, | 2.21 |
| 2665 | Methyl methacrylate | LL | 0.99 | | 0.90, | 1.10 | 2.42 | | 1.39, | 5.38 |
| 2650 | Methyl-2-pentanol, 4- | LL | 1.66 | | 1.27, | 2.32 | 2.00 | | 1.40, | 3.15 |
| 2660 | Methyl-2-pentanone, 4- | LL | 0.56 | | 0.46, | 0.69 | 1.63 | | 1.22, | 2.35 |
| 2550 | Methyl-3-butyn-2-OL, 2- | LL | 0.59 | | 0.44, | 0.86 | | X | | |
| | Methylal | LL | 1.37 | | 1.06, | 1.83 | 1.46 | | 1.24, | 1.74 |
| 2540 | Methylaniline, N- | HL | 4.64 | | 3.9., | 5.57 | 9.46 | | 2.55, | 33.20 |
| 2570 | Methylcyclohexane | LL | 0.48 | | 0.28, | 1.39 | 0.84 | | 0.66, | 1.09 |
| | Methylcyclohexene, 1- | LL | 0.44 | | 0.36, | 0.54 | 2.79 | | 1.79, | 5.12 |
| 2670 | Methylpentynol | LL | 1.17 | | 0.71, | 2.48 | 3.42 | | 1.83, | 8.54 |
| 2690 | Methylstyrene, A- | LL | 13.90 | | 9.50, | 21.50 | | B | | |
| 2700 | Morpholine | LL | 0.92 | | 0.67, | 1.40 | 2.59 | I | 0.64, | 10.50 |
| 2770 | Nitrobenzene | HL | | B | | | 0.01 | I | 0.00, | 82.80 |
| 2790 | Nitroethane | LL | 1.40 | | 1.20, | 1.65 | 3.46 | | 1.56, | 13.00 |
| 2791 | Nitromethane | LL | 3.52 | | 3.03, | 4.15 | 7.60 | | 1.91, | >100.00 |
| 2795 | Nitropropane | LL | 1.05 | | 0.80, | 1.48 | 2.02 | | 1.17, | 4.47 |
| | Nonane-N | LL | 1.54 | | 0.94, | 2.98 | 11.10 | | 3.13, | >100.00 |
| | Octane | LL | 1.03 | | 0.89, | 1.21 | 2.11 | | 1.68, | 2.75 |

TABLE G-1 (continued)

| OCPDB* ID no. | Compound name | Volatility class** | OVA |  |  |  | TLV |  |  |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  | Response factor |  | Confidence intervals |  | Response factor |  | Confidence intervals |  |
| 2851 | Pentane | LL | 0.52 |  | 0.42, | 0.66 | 0.63 |  | 0.57, | 0.70 |
| 2873 | Picoline, 2- | LL | 0.43 |  | 0.36, | 0.50 | 1.18 |  | 1.08, | 1.29 |
|  | Propane | G | 0.55 | I | 0.46, | 0.72 | 0.60 | P | 0.59, | 0.69 |
| 3063 | Propionaldehyde | LL | 1.14 |  | 1.00, | 1.32 | 1.71 |  | 1.11, | 3.06 |
| 3066 | Propionic acid | LL | 1.30 |  | 1.03, | 1.70 | 5.08 | D | 0.73, | >100.00 |
| 3070 | Propyl alcohol | LL | 0.93 |  | 0.77, | 1.16 | 1.74 |  | 1.06, | 3.50 |
|  | Propylbenzene, N- | LL | 0.51 |  | 0.45, | 0.58 |  | B |  |  |
| 3090 | Propylene | G | 0.77 |  | 0.44, | 2.66 | 1.74 | I | 0.15, | 20.30 |
| 3120 | Propylene oxide | LL | 0.83 |  | 0.74, | 0.95 | 1.15 |  | 0.69, | 2.46 |
| 3130 | Pyridine | LL | 0.47 |  | 0.40, | 0.55 | 1.16 |  | 1.05, | 1.34 |
| 3230 | Styrene | LL | 4.22 |  | 3.45, | 5.27 |  | B |  |  |
| 3290 | Tetrachloroethane, 1,1,1,2- | LL | 4.85 | D | 1.24, | >100.00 | 6.91 |  | 3.14, | 22.50 |
| 3291 | Tetrachloroethane, 1,1,2,2- | LL | 7.89 |  | 5.01, | 13.80 | 23.40 |  | 8.06, | >100.00 |
| 2860 | Tetrachloroethylene | LL | 2.97 |  | 1.71, | 6.11 |  | B |  |  |
| 3349 | Toluene | LL | 0.39 |  | 0.36, | 0.45 | 2.68 | D | 0.79, | >100.00 |
| 3393 | Trichlorobenzene, 1,2,4- | HL | 1.21 | I | 0.50, | 2.94 | 0.47 | I | 0.32, | 0.68 |
| 3395 | Trichloroethane, 1,1,1- | LL | 0.80 |  | 0.72, | 0.90 | 2.40 |  | 1.81, | 3.35 |
| 3400 | Trichloroethane, 1,1,2- | LL | 1.25 |  | 1.06, | 1.50 | 3.69 |  | 2.77, | 5.16 |
| 3410 | Trichloroethylene | LL | 0.95 |  | 0.83, | 1.09 | 3.93 |  | 2.08, | 6.32 |
| 3420 | Trichloropropane, 1,2,3- | LL | 0.96 |  | 0.64, | 1.78 | 1.99 |  | 1.27, | 3.82 |
| 3450 | Triethylamine | LL | 0.51 |  | 0.40, | 0.70 | 1.48 |  | 0.96, | 2.76 |
| 3510 | Vinyl acetate | LL | 1.27 |  | 0.95, | 1.82 | 5.91 | D | 1.26, | >100.00 |
| 3520 | Vinyl chloride | G | 0.84 |  | 0.61, | 1.38 | 1.06 |  | 0.59, | 4.60 |
|  | Vinyl propionate | LL | 1.00 | I | 0.57, | 1.74 | 1.21 | I | 0.46, | 3.20 |
| 3530 | Vinylidene chloride | LL | 1.12 |  | 0.87, | 1.52 | 2.41 |  | 1.82, | 3.35 |
| 3570 | Xylene, P- | LL | 2.12 |  | 1.71, | 2.68 | 7.87 |  | 3.49, | 24.90 |
| 3580 | Xylene, M- | LL | 0.40 |  | 0.36, | 0.46 | 5.87 | D | 0.91, | >100.00 |
| 3560 | Xylene, O- | LL | 0.45 |  | 0.28, | 0.85 | 1.40 |  | 0.61, | 9.33 |

*Organic Chemical Producers Data Base
**G = gas; LL = light liquid; HL = heavy liquid

Definition of explanatory data codes:

I = inverse estimation method
D = possible outliers in data
N = narrow range of data
X = no data available
B = 10,000 ppmv response unachievable
P = suspect points eliminated

## TABLE G-2. TESTED COMPOUNDS WHICH APPEAR TO BE UNABLE TO ACHIEVE AN INSTRUMENT RESPONSE OF 10,000 PPMV AT ANY FEASIBLE CONCENTRATION

| OVA | | TLV | |
|---|---|---|---|
| **OCPDB*** | **Compound name** | **OCPDB** | **Compound name** |
| — | Acetyl-1-propanol, 3- | 120 | Acetophenone |
| 790 | Carbon disulfide | — | Acetyl-1-propanol, 3- |
| 810 | Carbon tetrachloride | 130 | Acetylene |
| — | Dichloro-1-propanol, 2,3- | 160 | Acrylic acid |
| — | Dichloro-2-propanol, 1,3- | 360 | Benzaldehyde |
| — | Diisopropyl benzene, 1,3- | 450 | Benzonitrile |
| — | Dimethylstyrene, 2,4- | 490 | Benzoyl chloride |
| 1221 | Freon 12 | 530 | Benzyl chloride |
| 2073 | Furfural | — | Butylbenzene, Tert- |
| — | Methyl-2,4-pentanediol, 2- | 810 | Carbon tetrachloride |
| 1660 | Monoethanolamine | 930 | Chloroform |
| 2770 | Nitrobenzene | 1040 | Crotonaldehyde |
| 2910 | Phenol | 1060 | Cumene |
| — | Phenyl-2-propanol, 2- | 1130 | Cyclohexanol |
| | | — | Dichloro-1-propanol, 2,3- |
| | | — | Dichloro-2-propanol, 1,3- |
| | | — | Diisopropyl benzene, 1,3- |
| | | — | Dimethylstyrene, 2,4- |
| | | 2060 | Formic acid |
| | | 1221 | Freon 12 |
| | | 2073 | Furfural |
| | | 2200 | Isobutylene |
| | | — | Methyl-2,4-pentanediol |
| | | 2690 | Methylstyrene, A- |
| | | 1660 | Monoethanolamine |
| | | 2910 | Phenol |
| | | — | Phenyl-2-propanol, 2- |
| | | — | Propylbenzene, N- |
| | | 3230 | Styrene |
| | | 2860 | Tetrachloroethylene |

*Organic chemical producers data base ID number.

# APPENDIX H

# PORTABLE VOC DETECTION DEVICES

# APPENDIX H

## PORTABLE VOC DETECTION DEVICES

The three tables listed in this Appendix were taken from:

> Environmental Protection Agency (EPA). March 1980. Summary of Portable VOC Detection Instruments. EPA 340/1-80-010.

The instruments are classified as ionization detectors, infrared detectors, or combustion detectors. These tables are only a general guide as to the instruments that are being marketed for various uses. Specific applicability for VOC leak detection must be determined by an analyzer's ability to meet the specifications and performance criteria listed in EPA Reference Method 21.

## TABLE H-1. PORTABLE IONIZATION DETECTORS

| Manufacturer | Model no. | Pollutant(s) detected | Principle of operation | Cost ($) | Weight (lb) | Range (ppm) | Accuracy (%) | Sensitivity | Precision (%) | Response time (s) |
|---|---|---|---|---|---|---|---|---|---|---|
| Analytical Instrument Development, Inc., Avondale, Pennsylvania | 550[a] and 551 | Nonmethane total hydrocarbons | FID | 3711 | 16.5 | 0-200 and 0-2000 for Model 550; 0-200 and 0-10,000, for Model 551 | ± 3 | 0.1 ppm on a scale of 0-200 ppm | ± 3 | 5 |
| | 555[b] | Total hydrocarbons | FID | 3987 | 20.5 | 0-10,000, 0-2000, and 0-100 | ± 3 | 1 ppm on a scale of 0-2000 ppm | ± 3 | 5 |
| | 511-12[c] | Total hydrocarbons and individual compounds with GC | FID/GC | 4968 | 41 | | | 0.05 ppm as propane | | |
| Bendix, Environmental and Process Instruments Division, Lewisburg, West Virginia | 8401[d] | Total hydrocarbons | FID | 3195 | 40 | 1-1000 | ± 2 | 0.01 ppm | ± 2 | 8 |
| Foxboro, S. Norwalk, Conn. | OVA-118 | Total hydrocarbons | FID | 3500 | 12 | 0-10 and 0-100 | ± 2 | 0.2 ppm methane | ± 2 | 2 |
| | OVA-128[e] | Total hydrocarbons | FID/GC | 4200 | 12 | 0-1000 | ± 2 | 0.2 ppm methane | | |
| | OVA-98 | Total hydrocarbons | FID | 3500 | 12 | 0-10,000 | ± 2 | 0.5 ppm methane | ± 2 | 2 |
| | OVA-108[f] | Total hydrocarbons | FID/GC | 4200 | 12 | 0-10,000 | ± 2 | 0.5 ppm methane | | |
| General Electric, Instrument Products, Lynn, Massachusetts | TVM-1 | Halogenated compounds | Ion capture[g] | 4060 | 23 | 9 ranges: 0-1 through 0-10,000 | ± 10 | 0.1 ppm | | 120 |
| Heath Consultants, Inc., Stoughton, Massachusetts | Detecto PAK II[h] | Total hydrocarbons | FID | 2950 | 8 | 0-10<br>0-100<br>0-1000 | ± 4 | 2 ppm<br>2 ppm<br>5 ppm | | 15 |

TABLE H-1 (continued)

| Manufacturer | Model no. | Pollutant(s) detected | Principle of operation | Cost ($) | Weight (lb) | Range (ppm) | Accuracy (%) | Sensitivity | Precision (%) | Response time (s) |
|---|---|---|---|---|---|---|---|---|---|---|
| HNU Systems, Inc., Newton Upper Falls, Massachusetts | PI-101[a] | Chlorinated hydrocarbons, aromatics, aldehydes, ketones, any substance which adsorption of UV light results in ionization | Photoionization | 3395 | <9 | 0-20,<br>0-200, and<br>0-2000 | −7<br>−7 | 1 ppm | 5 | |
| Melroy Labs Springfield, Virginia | HC-500 | Total hydrocarbons | FID | | 40 | 0-10,<br>0-50, 0-100,<br>0-500, and<br>0-1000 | ±1 on low scale | 0.1 ppm $CH_4$ | ±1 | 45 |
| Mine Safety Appliances Co., Pittsburgh, Pennsylvania | Total HC analyzer | Total hydrocarbons | FID | 3850 | 35 | 0-4 and<br>0-12,000 | ±1% | | | |
| Survey and Analysis, Inc. Northboro, Massachusetts | Snifty Model A 500[i] | Total hydrocarbons | FID | 1695 for basic unit, $2295 for entire portability package | 17 | 0-10<br>0-100<br>0-1000<br>0-10,000 | −55<br>−35<br>−3<br>+20 | 2 ppm | | 4 |

[a] A charcoal tube is used to adsorb organics except methane, and a range of 0-10 ppm is available with the recorder. The instrument can be used as alarm by setting in 0-1000 range. This is a screening and leak detection device.

[b] The following features are available: a range of 0-100 ppm with recorder only; internal power, oxygen, and hydrogen supplies; a heated probe; and a battery-operated recorder with a range of 0-100 mV d.c.

[c] Capabilities equal or exceed those of Models 550 and 555.

[d] Capabilities to detect higher concentrations require further investigation. This may be suitable for ambient air measurement only.

[e] Optional GC.

[f] Optional GC.

[g] A heated platinum wire embedded in rubidium combusts incoming gases. Combustion of halogenated materials causes electrons to flow from the rubidium. The electrical flow measured is proportional to the amount of halogenated materials present.

[h] Performance characteristics as measured by NIOSH. Reference 6, Section 3.

[i] Inaccurate.

## TABLE H-2. PORTABLE INFRARED DETECTORS

| Manufacturer | Model no. | Pollutant(s) detected | Principle of operation | Cost ($) | Weight (lb) | Range (ppm) | Accuracy (%) | Sensitivity | Precision (%) | Response time (s) |
|---|---|---|---|---|---|---|---|---|---|---|
| Anarad, Inc., Santa Barbara, California | AR-400[a] | Individual species absorbing IR | IR | 2395 for an analyzer measuring single gas<br>5745 for an analyzer measuring three gases (Model 403) | | | ±1 | < ±1 | 5 | |
| Astro Resources Corp., Houston, Texas | 5000[b] | Individual hydrocarbons | IR | | 25 | Specified by customer, up to 100% | ±1 | ±1 | | |
| Chrysler Huntsville Electronics Division Huntsville, Alabama | III-C[c] | Total hydrocarbons | IR | | 20 | 0-300 and 0-2000 ppm | ±2 | ±2 | 6 | |
| | Mopar[c] | Total hydrocarbons | IR | | 20 | 0-300 and 0-2000 ppm | ±2 | ±2 | 6 | |
| | Atlas[c] | Total hydrocarbons | IR | | 30 | 0-300 and 0-2000 ppm | ±2 | ±2 | 6 | |
| Foxboro Analytical, Wilks Infrared Center, S. Norwalk, Connecticut | Miran-104[d] | Any species absorbing IR between 2.5 and 14.5 μm in wavelength | IR | Not sold in United States but price may be similar to Miran-1A | 24 | ppm to percent | ±5 | 1 ppm | | 1,4,10, and 40 |
| | Miran-1A | Any species absorbing IR between 2.5 and 14.5 μm in wavelength | IR | 6600 | 32 | <ppm to percent | 3-4 | 1-2 | 1,4,10, and 40 | |

TABLE H-2 (continued)

| Manufacturer | Model no. | Pollutant(s) detected | Principle of operation | Cost ($) | Weight (lb) | Range (ppm) | Accuracy (%) | Sensitivity | Precision (%) | Response time (s) |
|---|---|---|---|---|---|---|---|---|---|---|
| Gas Tech, Inc., Mountain View, California | Halide detector | Halogenated hydrocarbons | Enhancement of radiation from a spark by halogens | 1125 | 13 | 0-100 and 0-10,000 ppm | | | 5 | |
| Infrared Industries, Inc., Santa Barbara, California | IR-711 | Alkane hydrocarbons | IR (solid state detector) | 1250 | 9 | 0-100% LEL and 0-1000 ppm | ±5 | ±5 | 120 | |
| | IR-702[e] | Any species absorbing IR | IR | 2895 | 34 | IR-702, IR-703, and IR-705 are available with analog or digital scales; analog scales range from 0-100% to 0-200 ppm; digital scales range from 0-100% to 0.1% | ±1 | | 5 | |
| | IR-703[e] | Any species absorbing IR | IR | 2395 | 34 | | | | | |
| | IR-705[e] | Any species absorbing IR | IR | 2950 | 34 | | | | | |
| Mine Safety Appliances Co., Pittsburgh, Pennsylvania | LIRA 303[f] | Hydrocarbon species that absorb IR | IR | 2970 | 37 | 0-100% LEL and 0-1000 ppm | | ±1 | 5 | |

[a] Available in single and dual component versions.
[b] Factory-calibrated for gas to be detected in application.
[c] Autoexhaust analyzers; solid state detectors.
[d] Miran-101 and Miran 103 do not have built-in, multiparameter capabilities. Their measurement range is from 0 to 1000 ppm for most species.
[e] IR-702, IR-703, and IR-705 are usually bench- or panel-mounted instruments. IR-702 is a dual component instrument; and IR-703 and IR-705 are single component instruments.
[f] Can be calibrated to measure a single gas or a mixture if the instrument is panel-mounted.

## TABLE H-2. PORTABLE COMBUSTIBLES DETECTORS

| Manufacturer | Model no. | Pollutant(s) detected | Principle of operation | Cost ($) | Weight (lb) | Range (ppm) | Accuracy (%) | Sensitivity | Precision (%) | Response time (s) |
|---|---|---|---|---|---|---|---|---|---|---|
| Bacharach Instrument Co., Santa Clara, California | G<br>L<br>H[a]<br>TLV Sniffer[b] | Combustible gases | Catalytic combustion<br>Catalytic combustion | 253<br>160<br>279<br>896 | 4<br>4<br>5<br>5 | 0-100% LEL<br>0-100% LEL<br>0-100% LEL<br>0-100, 0-1000, and 0-10,000 ppm | ±3 | 2 ppm | ±3 | |
| Biomarine Industries, Inc., Malvern, Pennsylvania | 922 | Combustible gases and vapors | Catalytic combustion | 495 | 1.5 | 0-100% LEL | ±5% LEL | | 5 | |
| | 900, 900 R, and 900 RS | Combustible gases and vapors | Catalytic combustion | 685 695, and 715 | 3 | 0-100% LEL | ±5% LEL | | 5 | |
| Control Instruments Corp., Fairfield, New Jersey | FFAP[c] | Flammable gases and vapors | Thermal combustion | | 28 | 0-100% LEL | ±3 | ±1 | <10 | |
| Gas Tech, Inc., Mountain View, California | 1177 | Combustible gases | Catalytic combustion | 525 | 6 | 0-100% LEL | ±5 | ±2 | 4 | |
| | 1238 | Combustible gases | Catalytic combustion | 695 | 7 | 0-100% LEL and 0-500 ppm | ±2 | ±2 | 10 | |
| International Sensor Technology, Santa Ana, California | AG5100 | Combustible gases and vapors | Change in resistance within detector | 1200 for ppm scale, 825 for LEL scale | | LEL and ppm | ±5 | ±5 | 10 on LEL scale and 60 on ppm scale | |
| Mine Safety Appliances Company, Pittsburgh, Pennsylvania | 20[d] | Combustible gases | Catalytic combustion | 374 | 6 | 0-100% LEL | | | | |
| | 30[e] | Combustible gases | Catalytic combustion | 374 | | 0-100% LEL | | | | |
| | 40[f] | Combustible gases | Catalytic combustion | 374 | | 0-10% and 0-100% LEL | | | | |

## TABLE H-2 (continued)

| Manufacturer | Model no. | Pollutant(s) detected | Principle of operation | Cost ($) | Weight (lb) | Range (ppm) | Accuracy (%) | Sensitivity | Precision (%) | Response time (s) |
|---|---|---|---|---|---|---|---|---|---|---|
| Survey and Analysis, Inc. Northboro, Massachusetts | OnMark Model 5[e] | Combustible gases and vapors | Thermal conductivity | 285 | <5 | 0-5 and 0-100% | ± 3 |  | ± 3 | <10 |
| Teledyne Analytical Instruments, San Gabriel, California | 980 | Total combustibles and oxygen | Catalytic combustion |  | 17 | Scale: 0-5% methane; others are available | ± 2 | 0.5% of full scale |  | 20 |

[a] Catalytic combustion (hotwire) in low range and thermal conductivity in high range.

[b] The ranges of TLV can be multiplied by 10 with a dilution probe.

[c] The FFAP uses a propane flame to combust sample gas and is fully portable.

[d] Can be factory calibrated for five gases, such as pentane.

[e] Calibrated to measure natural gas and petroleum vapors in air mixtures.

[f] Factory calibrated for pentane.

[g] Filaments for the 0-100% scale are thermal sensors heated to 300° to 400°F, and filaments for the 0-5% scale are catalytic sensors heated to 1200° to 1300°F.

# APPENDIX I

# CARBON CANISTER MONITORING FREQUENCY

# APPENDIX I

## CARBON CANISTER MONITORING FREQUENCY

Carbon canisters are normally limited to controlling low-volume, (typically 100 $ft^3$/min, maximum) intermittent gas streams, such as those emitted by storage tank vents or process vents on small batch operations. Once the carbon reaches a certain organic content, the unit is shut down, replaced with another canister, and disposed of or regenerated by an off-site facility.

In accordance with Parts 264 and 265 Subparts AA and BB, carbon adsorption systems that do not regenerate the carbon bed directly on-site in the control device (e.g., carbon canisters) are required to monitor for breakthrough at a frequency interval of once a day or 20 percent of the time required to consume the total carbon adsorption capacity, whichever is less frequent. An example illustrating how to determine monitoring frequency follows:

**Example**: A carbon adsorption system is used to control emissions from a source with 0.5 lb/h (total organics) in the vent stream. The system operates 8 hours (1 shift) per day. The carbon canister contains 175 lb of carbon with a working capacity of 0.06 lb organic/lb carbon. The required monitoring frequency for this system is determined as follows.

**Solution**: The time required for breakthrough is calculated as follows:

$$\frac{175\ \text{lb carbon}}{\text{canister}} \times \frac{0.06\ \text{lb organics}}{1\ \text{lb carbon}} \times \frac{1\ \text{h}}{0.5\ \text{lb organics}} \times \frac{1\ \text{d}}{8\ \text{hours}} = \frac{2.6\ \text{d}}{\text{canister}}$$

2.6 d is the time required to consume the carbon adsorption capacity of one canister. Twenty percent of 2.6 d is 0.5 d; because this is less than 8 h (1 d operating time), the required frequency of monitoring would be daily (once per shift). If 20 percent of the breakthrough time would have been 16 h, monitoring would be required only once every 16 h or every other operating shift (day).

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*(Please read Instructions on the reverse before completing)*

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15. SUPPLEMENTARY NOTES

16. ABSTRACT

On June 21, 1990, standards were promulgated to control organic air emissions from process vents and equipment leaks at hazardous waste treatment, storage, and disposal facilities. The standards were developed under Section 3004(n) of the Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act (RCRA). This document is designed to provide technical guidance for RCRA permit writers and reviewers who will implement the standards.

17. KEY WORDS AND DOCUMENT ANALYSIS

| a. DESCRIPTORS | b. IDENTIFIERS/OPEN ENDED TERMS | c. COSATI Field/Group |
|---|---|---|
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